RADIO — ELECTRONICS

FEBRUARY 1953

LATEST IN TELEVISION • SERVICING • AUDIO

HUGO GERNSBACK, Editor

SUCCESSFUL WOMAN SERVICE OPERATOR

See page 4

30¢

U. S. and CANADA

In this issue: **Restoring Peak TV Performance • Transistor Preamplifier • High-Quality AM Tuner**

These RCA Radio Batteries

Provide balanced service life in new "Personal" sets

This new portable-radio battery combination is radio-engineered for longer service life, less frequent change of batteries.

YES, this is the famous battery combination that provides *balanced* service life . . . greatly increases the playing time of "personal"-type portable radios. These RCA Batteries are opening up a tremendous new radio-battery replacement market that's expanding every day—a *new* profit-maker for you.

LOOK AT THESE FEATURES

FIRST RADIO BATTERY (RCA VS216) WITH ALKALINE DRY CELLS

More power per cell from active ingredients more effectively used . . . RCA VS216 "B" Battery is nearly 25 per cent smaller in size than previous types, yet provides almost twice the service life.

FIRST WITH "BALANCED POWER" FOR "PERSONALS"

The new VS216 "B" Battery is used with two of the new "A" batteries, VS236, to give balanced life in a "personal"-type portable that provides virtually the same playing hours as a larger portable set equipped with the RCA VS050 portable "AB" radio pack.

LEAK-RESISTANT "A" AND "B" BATTERIES

Encased-in-steel construction . . . leak-resistant. This construction helps protect portable radios from battery swelling and corrosion.

LOWER COST PER OPERATING HOUR

A 25 per cent saving in battery operating cost over that of old-style "personal"-type portable radios. These new RCA types play new "personal"-type portable radios many times longer without change of batteries.

REMEMBER . . . RCA Radio Batteries are sold principally through Radio Service Dealers. RCA Battery advertising sends customers to you for battery replacements.

GET SET for 1953's big radio-battery replacement business and a big list of satisfied customers. Call your RCA Battery Distributor *today*.

RADIO CORPORATION of AMERICA

RADIO BATTERIES **HARRISON, N. J.**

Investigate this professional school— whose graduates are wanted, well paid and respected by the entire electronics industry

An open letter to young men of ambition from a pioneer in the field of radio-TV education

by

E. H. RIETZKE, *Founder and President of*
CAPITOL RADIO ENGINEERING INSTITUTE

IF YOU HAD TRAVELED with me on my recent trip across the United States and Canada, you would have seen with me the proud, grateful, earnest faces of CREI graduates and students. Proud that they had converted ambition into success. Grateful for what CREI had given them. Earnest in their plea to you to study for success.

Personnel Directors and Chief Engineers thanked me for personnel we had sent them—and bombarded me with requests for more.

I received the same reaction in every electronics installation, TV and radio station and factory I visited. I was proud that the professional school which I founded could point to such a fine record of accomplishment.

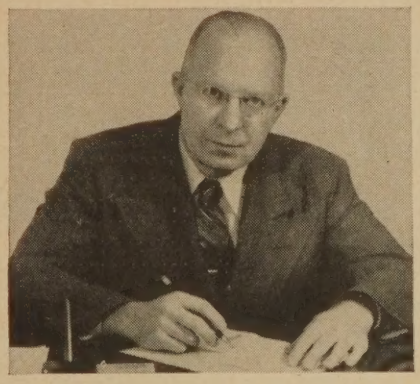
But I realized that our job has just begun. The growth of the electronics industry thus far is just a trickle compared to the future.

There are already 111 television stations. The FCC, by its "unfreezing" action, makes way for 2000 more stations. Over 18,000,000 TV sets are in use—that is 5,000,000 more than experts predicted there would be in 1954. There are over 100,000,000 radios in operation—in 95% of America's homes—and served by over 2500 radio stations.

Billions in electronics contracts have been awarded in the defense build-up. By 1960, it is estimated that the radio-electronics industry should do no less than $10,000,000,000 per year, not counting military orders.

This is but a fraction of the picture of expansion.

There is already a gaping shortage of trained men to accept the thousands of openings in development, research, design, production, testing, inspection, manufacture, broadcasting, telecasting and servicing. The best jobs, the highest rewards, the posts of leadership are going to the trained men. And the better the training—the better the results.



If you are a beginner, CREI is not the school for you. There are other schools equipped to do much more for you. In a year or two, they can bring you to the point where you can profitably enroll at CREI.

If, however, you are a graduate of one of these other schools—or if you have been gainfully employed in the Radio-TV-Electronics industry for one year, or more, CREI can help change your life.

I founded CREI more than 25 years ago to provide professional level advanced training for men in the field. 98% of all our students were employed in electronics at the time they enrolled.

I can safely say that we have more contracts with leading companies for group training—than all other radio educational institutions combined. Let me mention just a few: United Air Lines, Columbia Broadcasting System, Canadian Broadcasting Corporation, Trans-Canada Air Lines, Bendix Products Division, All-American Cables & Radio, Inc., RCA-Victor Division, the Machlett Laboratories—all have chosen CREI technical courses for group training of their own electronic personnel.

In CREI's Home Study Course you will receive authentic and complete courses, prepared by recognized experts, in a practical, easily-understood manner. You will learn under the supervision of a staff instructor. Your work will be graded by your instructor, not by machine. Return letters will indicate where you can improve. Your CREI diploma will be your key to success.

CREI's home study courses, and residence school, are accredited by the Engineers' Council for Professional Development.

The best way to find out about CREI is the way I am now going to suggest. Talk to your supervisor, to the chief engineer of your local radio or television stations, to CREI graduates, to the officials of any radio school—anywhere. I, with every member of the distinguished CREI faculty, am ready to stand on whatever answer they give you.

We have prepared a booklet called "Your Future in the New World of Electronics." In it you can find the breath-taking future of the industry, translated into *your* future. It contains an outline of the CREI curriculum that can transform your life from one of placid, plodding, ordinariness—to a full, happy, successful life of leadership in the fastest growing industry in the world.

Having expressed my pride in the past of the educational system and institution I represent, I make this pledge:

> Wherever there is a man of ambition, I want to help him achieve the highest of which he is capable—in the glamorous, rewarding world of Electronics.

May I hear from you soon?

CREI resident instruction offered in Wash., D. C. VETERANS: If discharged after June 27, 1950, check last line of coupon for information about new G. I. Bill.

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RADIO-ELECTRONICS

Formerly RADIO-CRAFT • Incorporating SHORT WAVE CRAFT • TELEVISION NEWS • RADIO & TELEVISION*

ON THE COVER (See page 30)

Mrs. Juliette Drut, owner and manager of Rondel TV, Bronx, N. Y., engaged in studying an interesting service problem.

Color original by Avery Slack

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FEBRUARY, 1953

MEMBER Audit Bureau of Circulations

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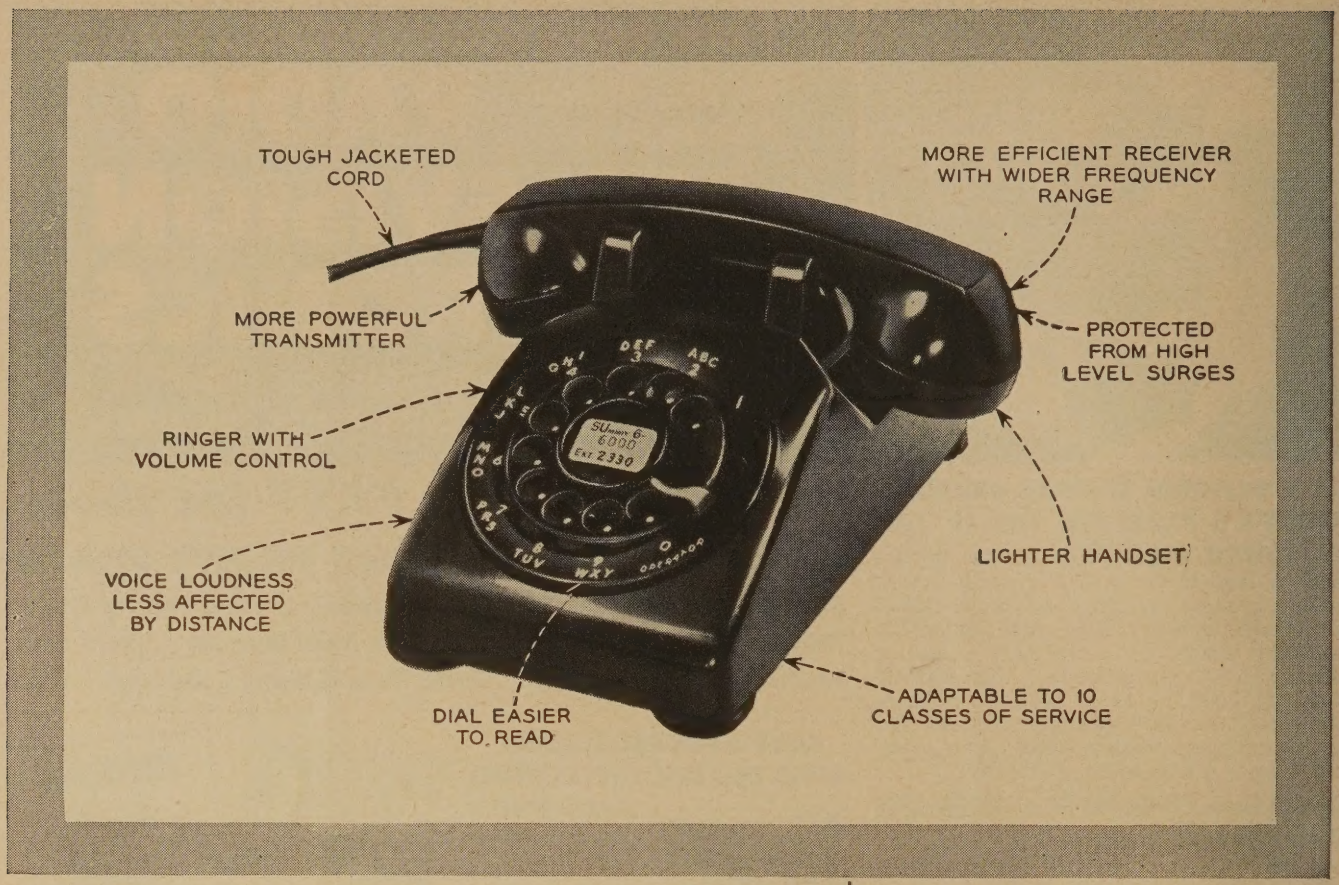


New "500" telephone. It has already been introduced on a limited scale and will be put in use as opportunity permits, in places where it can serve best. Note new dial and 25 per cent lighter handset.

It adds miles to your voice

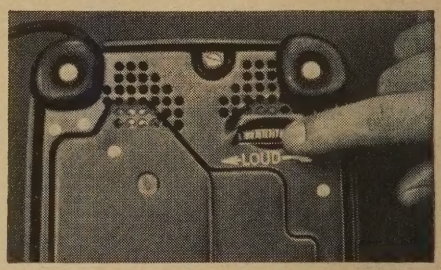
For years the telephone you know and use has done its job well—and still does. But as America grows, more people are settling in suburban areas. Telephone lines must be longer; more voice energy is needed to span the extra miles.

Engineers at Bell Telephone Laboratories have developed a new telephone which can deliver a voice ten times more powerfully than before. Outlying points may now be served without the installation of extra-heavy wires or special batteries on subscribers' premises. For shorter distances, the job can be done with thinner wires than before. Thus thousands of tons of copper and other strategic materials are being conserved.

The new telephone shows once again how Bell Telephone Laboratories keeps making telephony better while the cost stays low.

BELL TELEPHONE LABORATORIES

Improving telephone service for America provides careers for creative men in scientific and technical fields.



Adjustable volume control on bottom of new telephone permits subscriber to set it to ring as loudly or softly as he pleases. Ring is pleasant and harmonious, yet stands out clearer.

QUICK FACTS ON NEW TELEPHONE

Transmitter is much more powerful, due largely to increased sound pressure at the diaphragm and more efficient use of the carbon granules that turn sound waves into electrical impulses.

Light ring armature diaphragm receiver produces three times as much acoustic energy for the same input power. It transmits more of the high frequencies.

Improved dial mechanism can send pulses over greater distances to operate switches in dial exchange.

Built-in varistors equalize current, so voices don't get too loud close to telephone offices.

Despite increased sensitivity of receiver, "clicks" are subdued by copper oxide varistor which chops off peaks of current surges.

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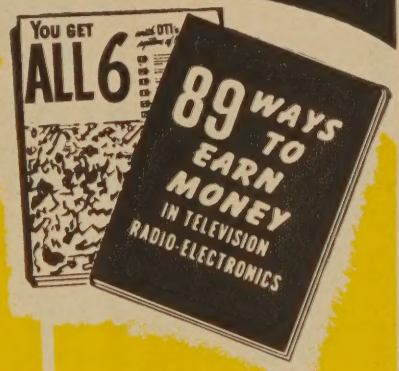
(1) at HOME . . . or

(2) in one of nation's finest TV training laboratories



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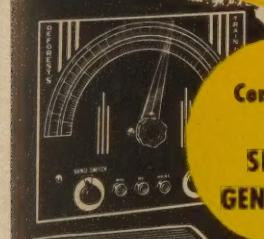

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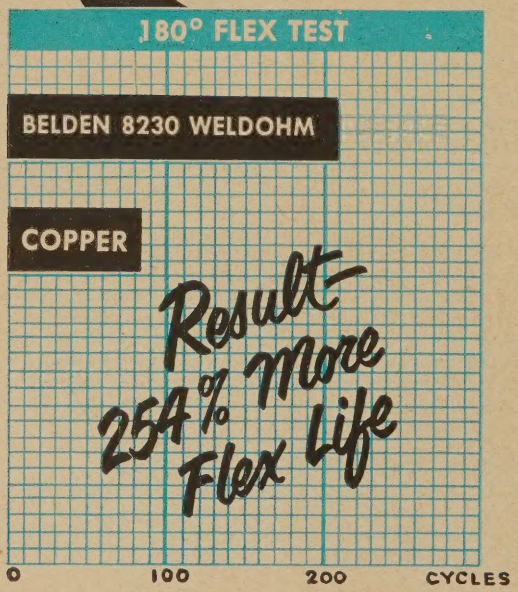

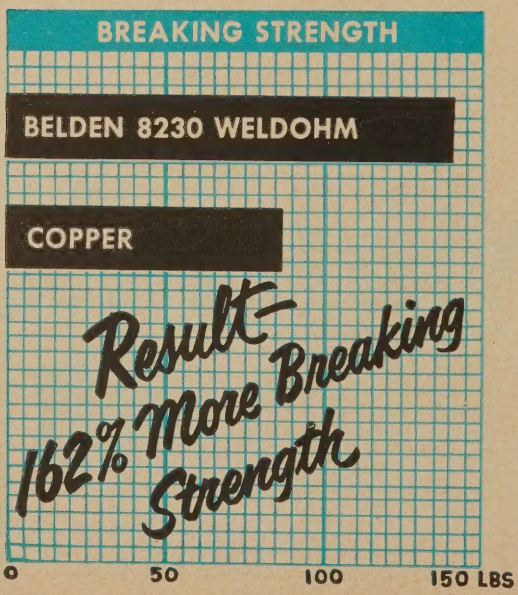

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Brown Polyethylene-Resists Weather and Oxidation

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Reducing TV lead-in conductor breakage to a minimum is easy. The new Belden Weldohm Cable has overcome the breakage point by 162%, that's 1½ times the strength of pure copper wire.

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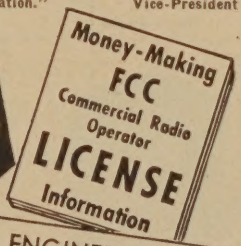

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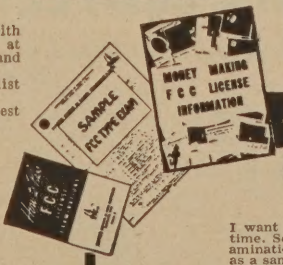

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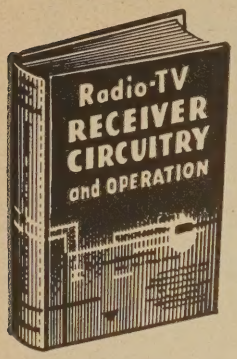

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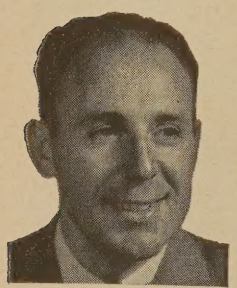

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First, RADIO & TV RECEIVER TROUBLESHOOTING & REPAIR teaches you all about modern troubleshooting and test methods. You learn how to locate common troubles in the quickest, easiest ways. You learn all about trouble sources in components. You learn to make simple "static" tests—then progress rapidly to dynamic signal tracing and signal injection techniques.

HOW-TO-DO-IT CHARTS HELP YOU LEARN FASTER

Special problems in hard-to-fix sets are clearly explained. Step-by-step charts show every detail of modern service procedure in jig time. Receiver alignment, tuning problems, speaker troubles, intermittents and dozens of other tough jobs are made so clear you cannot fail to understand them.

Most important of all, this new book brings you the latest television service procedures in addition to complete coverage on radio problems.

To the beginner, it is a complete service training course. To the established serviceman, it is a guide to every detail of profitable modern methods and also serves as on-the-job reference in giving you quick solutions to puzzling service problems.

Read RADIO & TV RECEIVER TROUBLESHOOTING AND REPAIR for 10 days *at our risk.* Use coupon on opposite page!

MONEY-SAVING OFFER!

on Ghirardi's new 2-Vol. Service Training Course!

Get both of the above new Ghirardi service training books at a special combination price! Have the service data you need—when you need it! Sold separately, Radio & TV Circuitry and Operation and Radio & TV Receiver Troubleshooting and Repair would cost you $12.75. Bought as a combination you get both books for only $12.00—with the same privilege of returning them in 10 days if you don't like them.

Check *SPECIAL COMBINATION OFFER* in coupon on opposite page. Mail today!

Ghirardi's COMPLETE BASIC TRAINING *for beginners*

More people now in Radio-TV got their basic training from this famous book than any other book or course of its type!

36 COURSES IN ONE!

Ghirardi's RADIO PHYSICS COURSE

972 pages, 508 illus.

856 self-test review questions

Price only $5.00—the biggest buy in basic training on the market!

"The most complete training course in radio fundamentals ever offered"—that's what experts say about Ghirardi's world-famous RADIO PHYSICS COURSE. More widely used by Signal Corps, Navy, etc. in World War II, than any other basic radio training text. Everything is explained so clearly that you can understand every word without previous radio training of any kind.

Ghirardi's RADIO PHYSICS COURSE starts with Basic Electricity. Then it takes you step by step through the entire field of Radio-Electronics from simple circuits showing the basic functions of resistors, condensers, coils, transformers, etc., to the final applications of these circuits in home, auto, and aircraft radios, public address systems, etc. Subjects covered include Sound, Speech, Music, Electron Theory, Electric Circuits, Current, Resistance, Capacitance, Inductance, Transformers, Filters, Radio Waves, Vacuum Tubes, Radio Circuits, Loudspeakers and dozens of others. You get the kind of training you need—at a price you can afford to pay. If broken into "course" form and sent as monthly lessons, you'd regard it as a bargain at $50.00 or more. Instead you buy it for only $5.00—and you progress as fast as spare reading time permits.

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*(*Except PIX-O-FIX TV Troublefinder's Guide which is sold for cash only.)*

HANDLE UP TO 90% OF TV TROUBLESHOOTING *by easy picture analysis!*

This short cut way of handling television troubleshooting and repair can save you hundreds of dollars worth of time! You spot TV trouble symptoms at a glance—repair them lots faster!

Just "dial" PIX-O-FIX until the TV screen photo appearing in its "window" matches the screen picture on the set being repaired. PIX-O-FIX then indicates all possible causes of this particular trouble and the receiver section where they may occur. Step-by-step repair instructions follow.

PIX-O-FIX covers 24 common troubles; 190 possible trouble causes and 253 definite, easily-understood remedies. A truly professional service device—not a "fix-it-yourself" gadget for consumers. Priced at only $1.00.

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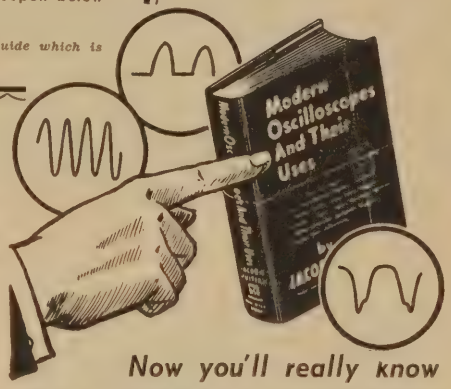
PIX-O-FIX TV
TROUBLEFINDER GUIDE
Price $1.00
(Outside U.S.A. $1.25)
Cash only—no free examination



MODERN OSCILLOSCOPES AND THEIR USES
by Jacob H. Ruiter, Jr.
326 pages, 370 illus.
Price $6.00

Now you'll really know

HOW TO USE OSCILLOSCOPES!

Learn to use the oscilloscope fully on all types of AM, FM, and Television service work—and watch your efficiency and earnings soar!

MODERN OSCILLOSCOPES AND THEIR USES, a fact-jammed 326-page book by Jacob H. Ruiter, Jr. of the Allen B. DuMont Laboratories contains exactly the help you need—and written in a way that makes these remarkable instruments perfectly understandable. It shows how to use your 'scope for faster, more accurate work on all types of jobs from troubleshooting to re-aligning. You learn how to make connections; how to set controls, and, above all, how to analyze patterns. 370 illustrations including dozens of pattern photos make things doubly clear.

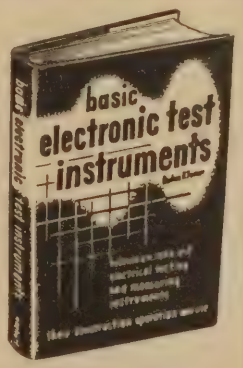
No other type of specific service training stands to mean so much to you in terms of being able to do better, faster and more profitable work!

It pays to know how to

USE ELECTRONIC TEST INSTRUMENTS

more effectively!

BASIC ELECTRONIC TEST INSTRUMENTS teaches you to use familiar instruments more fully; how to choose the right instrument for each job; how to operate and maintain them properly; and how to evaluate their readings and put them to practical use. You learn dozens of short-cuts in using instruments on hundreds of jobs. Best of all, BASIC ELECTRONIC TEST INSTRUMENTS saves money by helping you avoid buying unnecessary instruments—and it helps you handle even the complicated jobs with fewer instruments. In addition to the older instruments, the book covers all the newer types from grid-dip oscillators, to TV sweep and marker generators, distortion meters and many more. Read it for 10 days at our risk!



JUST OUT!
BASIC ELECTRONIC TEST INSTRUMENTS
255 pages, 171 illus.
Price $4.00

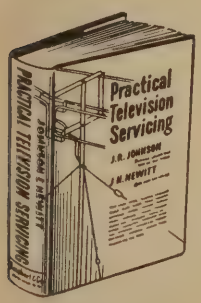
Let this "Automatic Teacher" show how to

REPAIR OVER 4,800 RADIO MODELS

Whether you repair radios for a living or work with them occasionally, Ghirardi's manual-size 744-page RADIO TROUBLESHOOTERS' HANDBOOK can save you time and money on a big percentage of jobs—*especially on older sets where data is so often lacking.* Eliminates useless testing!

Actually, this giant book contains specific trouble symptoms and their remedies for common troubles found in more than 4800 older sets of leading manufacturers. Just look up the case history notes on the set you want to fix. RADIO TROUBLESHOOTER'S HANDBOOK tells what the trouble is—what causes it—and exactly how to repair it. Hundreds of additional pages contain valuable data on old tubes, parts and equipment, plus graphs, diagrams and money-making service hints. Price only $5.00. 10-day free examination. Get yours while the limited supply of this great book lasts!

A QUICK GUIDE TO TELEVISION SERVICING



PRACTICAL TELEVISION SERVICING
by Johnson & Newitt
Price only $4.00

For those who already know radio, this is the book to help you make the jump to more profitable TV receiver servicing in the least time—at the lowest possible cost! PRACTICAL TELEVISION SERVICING with its 334 pages and 253 clear illustrations is a complete training course written so you can really understand it. First you learn how TV work differs from radio—how to set up shop—what equipment to get—what mistakes to avoid. Then you learn every detail of TV servicing from quick diagnoses of simple troubles to complicated instrument troubleshooting. Actual TV servicing case histories are worth their weight in gold and make tough jobs easier to understand. Read this big book for 10 days at our risk. Send coupon today!

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- ☐ **ELECTRONIC TEST INSTRUMENTS,** Price $4.00
- ☐ **PRACTICAL TELEVISION SERVICING,** Price $4.00
- ☐ **MODERN OSCILLOSCOPES AND THEIR USES,** Price $6.00
- ☐ **RADIO TROUBLESHOOTER'S HANDBOOK,** Price $5.00
- ☐ **PIX-O-FIX TV TROUBLEFINDER'S GUIDE,** Price $1.00. CASH ONLY—no free examination (Outside U.S.A. $1.25)

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JUNCTION TRANSISTORS are now available commercially. Raytheon Manufacturing Company has released part of its production on two types—CK721 and CK722—to industry through regular distributor channels. Both types fit standard subminiature sockets, and are expected to find unlimited application in commercial equipment. (Technical data on these units is given in the "New Tubes" section of this issue.)

Raytheon P-N-P junction transistors.

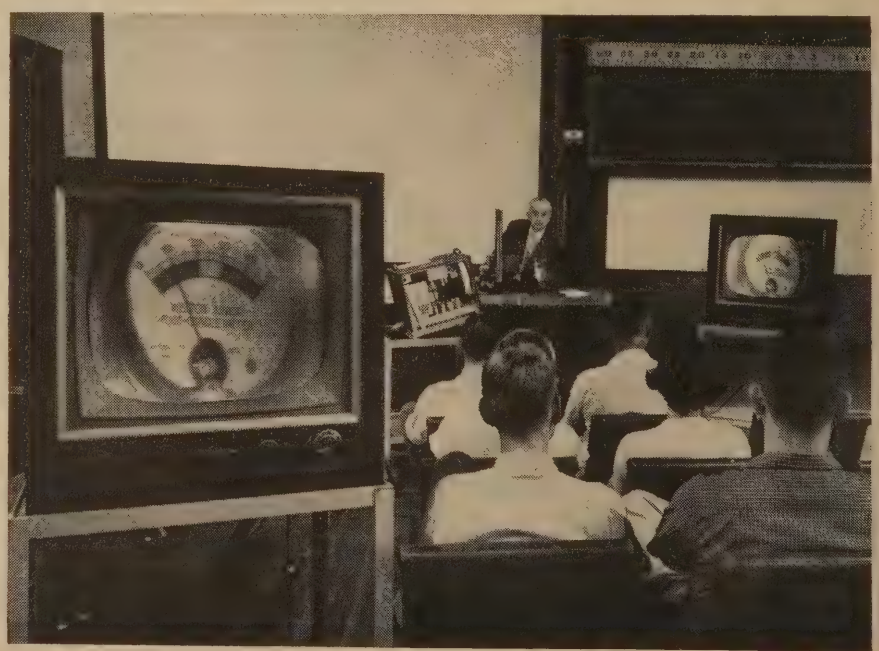
CLASSROOM TV SYSTEM gives every student a front seat. Cornell University's Department of Physics installed an RCA closed-circuit industrial TV system with 21-inch viewers in its largest lecture hall to let students see every detail of instructors' demonstrations. The new method conserves valuable laboratory equipment and eliminates duplication of complex and difficult experiments.

"PIPELINE" CONDUCTORS that carry electric power, TV programs, and microwave communications simultaneously are under development in the United States and Great Britain. Utilizing the Sommerfeld-Goubau "surface wave" principle, one microwave signal travels along the outside of the pipe. Power frequencies are carried by the solid portion, and the hollow interior serves as a waveguide for a second microwave channel. Dr. Goubau, who revived the original theory first proposed by Sommerfeld in 1899, is now carrying on research in this field for the United States Army Signal Corps. His work on the subject was described to the 1950 and 1951 conventions of the I.R.E. and was reported on in the May, 1950, and June, 1951, issues of this magazine.

A NEW THEORY OF HEARING has been proposed by Drs. Hallowell Davis and Ichiji Tasaki of the Central Institute for the Deaf, St. Louis, Mo. In a paper delivered at a recent meeting of the National Academy of Sciences, they suggested that the sensory cells in the ear do not merely transmit impulses derived from stimulation by sound waves, but act like carbon microphones —using the relatively weak sound stimulus to *control* a larger flow of energy from some internal source.

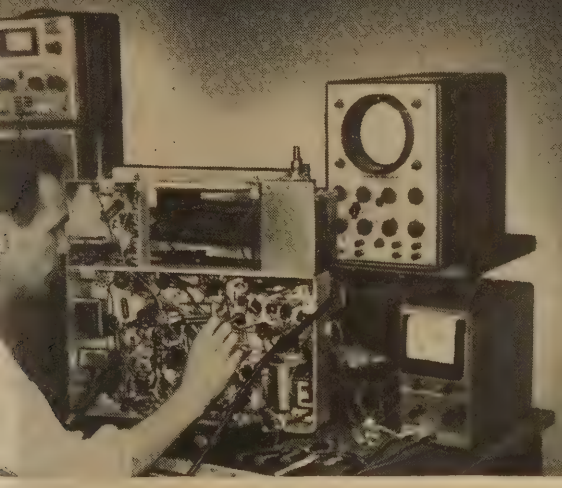
RENSSELAER POLYTECHNIC Institute, Troy, N. Y., has been licensed by the FCC to construct an experimental radar station for weather studies. Three air-borne weather-observation units will be placed in service as part of the program, which is under the supervision of Walter M. Nunn, Jr.

RTMA BACKS EDUCATIONAL TV stations, and urges member companies to aid their development as a "vital force in American life." The Association's endorsement was made known in



Professor Guy E. Grantham of Cornell's Department of Physics demonstrates lightmeter with RCA's midget camera and closed-circuit industrial TV system.

For opportunities within your reach



See what the RCA TV Servicing Course offers you

Good-pay jobs. A business of your own.

OPPORTUNITIES FOR GOOD-PAY JOBS in Television are within your reach when you study TV Servicing by the RCA Institutes Home Study Method. Or perhaps you would like to start a TV Service business of your own.

If you are not satisfied with the way your future now stacks up, see how easily you can change the course of your career. RCA Institutes Home Study Course in TV Servicing is helping thousands of other people to better jobs. It can help you. Right now thousands of opportunities are going begging. There is a critical shortage of trained TV servicemen. This is *your* big opportunity.

Easy-to-understand, illustrated lessons

The entire course is divided into ten units of several individual lessons. You study them at home in your spare time. Lesson-by-lesson you learn the theory and step-by-step procedures of installing TV antennas, of servicing and trouble-shooting TV receivers. Hundreds of pictures and diagrams help you understand the how-it-works information and the how-to-do-it techniques. You will be amazed how easily you absorb the knowledge of each lesson, how quickly you train yourself to become an experienced technician.

Experienced engineers and faculty prepared the course, grade your lessons

The RCA Institutes course was written and planned by instructors with years of specialized experience in training men by home-study and resident-school methods. The course embodies RCA's background of television experience plus knowledge gained in training several thousand technicians. A study of the course parallels an apprentice's training. Your lessons are carefully examined and accurately graded by friendly teachers who are interested in helping you to succeed.

One of the leading and oldest Radio-Television training schools

Founded in 1909, RCA Institutes, Inc. has been in continuous operation for the past 44 years. Its wide experience and extensive educational facilities give students, just like you, unsurpassed technical training in the highly specialized field of radio-television-electronics.

RCA Institutes is licensed by the University of the State of New York . . . an affiliate member of the American Society for Engineering Education . . . approved by the Veterans Administration . . . approved by leading Radio-Television Service Organizations.

It costs so little to gain so much

RCA Institutes makes it easy for you to take advantage of the big opportunities in TV Servicing. The cost of the TV Servicing Home Study Course has been cut to a minimum. You pay for the course on a pay-as-you-learn unit lesson basis. No other home study course in TV Servicing offers so much for so little cost to you.

RCA Institutes conducts a resident school in New York City offering day and evening courses in Radio and TV Servicing, Radio Code and Radio Operating, Radio Broadcasting, Advanced Technology. *Write for free catalog on resident courses.*

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a resolution by the Board of Directors, which also authorized Chairman A. D. Plamondon, Jr., to select a new head for the Committee on Educational Television. Benjamin Abrams, president of Emerson Radio and Phonograph Corp., and an outstanding advocate of educational television, asked to be relieved as committee chairman in order to take an even more active personal part in promoting the program.

DR. LEE de FOREST has received a patent on the color-TV screen which he described in his article "The Problem of Color TV," in RADIO-ELECTRONICS for January, 1950. The patent—No. 2,617,875—has been assigned to Allen B. du Mont Laboratories, Inc. Details of Dr. de Forest's invention are given in the "New Patents" department, on page 101 of this issue.

STATE TAX ON TV RECEIVERS was thrown out by Massachusetts legislative committee as "unfair and uncollectible." Sponsors of the tax had proposed a $2 levy on each TV set in the state to construct a state-owned educational TV station in Boston.

THYRATRON KEEPS HEART ALIVE in new stimulator reported by Dr. Paul M. Zoll of Harvard Medical School. No larger than a table radio, the thyratron stimulator produces adjustable electrical pulses which are applied to the heart through hypodermic-needle electrodes. In one case, where the ventricular muscles had failed completely, the patient's heart was kept beating for five days by the device.

FIRST CLOSED-CIRCUIT OPERA telecast from the Metropolitan Opera House in New York took place December 11. Seventy thousand people in 27 cities from New York to San Francisco saw a performance of "Carmen" in motion picture theaters linked to the private network.

AUDIO FAIR—LOS ANGELES will be held at the Alexandria Hotel, February 5, 6, and 7. Open to the public free of charge, the exhibit will include speaker, amplifier, phonograph, and tape-recorder products of nearly 100 American and foreign manufacturers. Los Angeles hi-fi enthusiasts will be given an opportunity to hear stereophonic sound reproduction of radio and recorded programs and see the most recent developments in home music systems and PA equipment.

The fair is sponsored by the Los Angeles chapter of the Audio Engineering Society.

MAGICIANS FEAR TELEVISION may give away the secrets of their craft by scanning every detail of their performances. Hoping to borrow a little magic from television itself, the British Ring of the International Brotherhood of Magicians has summoned the *genii* of the Marconi Company to devise new camera techniques that will keep their mysteries inviolate.

I.R.E. PRESIDENT FOR 1953 is Dr. James W. McRae, vice-president of Bell Telephone Laboratories. S. R. Kantebet, of the Government of India Overseas Communications, was elected vice-president of the Institute. Directors named for the 1953-1955 term are Stuart L. Bailey, of Jansky and Bailey, and B. E. Shackelford, of RCA International Division.

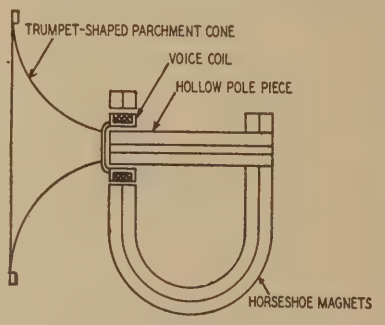
Dr. McRae, who has been associated with Bell Laboratories since 1937, served with the U.S. Army Signal Corps during World War II and was awarded the Legion of Merit. The new executives will be formally installed at the I.R.E. convention, to be held March 23, 24, 25, and 26 in New York City.

FCC AMATEUR REGULATION going into effect February 2, enables the Commission to declare a communications emergency in any area when necessary, and to ban all operation on specified frequency bands except by amateurs handling relief or emergency communications. The Commission will designate amateur stations to handle these communications, monitor the emergency bands, and warn offending stations. Frequency assignments for these services will be designated for each area by the local FCC field office.

NEW INTERNATIONAL STANDARDS for electrical symbols, radio components, electronic-tube basing and dimensions, and safety rules for amplifiers and loudspeakers were proposed by the International Electrotechnical Commission, which met in September at Scheveningen, Holland. The new standards must be approved by member associations representing 19 countries including the United States. Other specifications proposed included standards for paper tubular capacitors and suggestions for a universal color code for ceramic capacitors.

A REMINDER THAT TODAY'S PM dynamic speakers are based on a design 75 years old appeared in the December *Bulletin* of the Philadelphia Section of the I.R.E.

On December 10, 1876, C. H. Siemens received a British patent which covered every element of the modern moving-coil permanent-magnet speaker. The



Cross-section of the Siemens speaker

lack of dependable magnetic materials and amplifiers barred extensive use of the Siemens speaker for years, but it is still the basic patent in the field. END

Corner Reflector No. UHF400

When there are new worlds to conquer, JFD will do it!
Now our engineers have combined the famous JFD VHF Jetenna and UHF bowtie antenna into a miracle performer that pulls in all channels—from 2 to 83. Use it with the especially developed filter network* for perfect reception, completely free of inter-spectrum interference. Pre-assembled construction, all aluminum, even to solid aluminum dowels.

Write for the new 1953 JFD dealer almanac on your letterhead—36 pages of the widest TV antenna and accessory line in the industry.

*optional

"Bowtie-Vector" No. UHF600

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new, VHF-UHF All-Channel Antenna

—the Jet 283

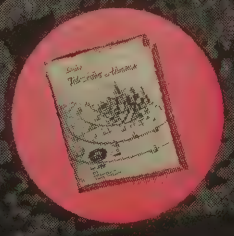
one antenna—one transmission line for all channels from 2 to 83

Ultra V-Beam No. UHF500

YAGIS No. UHF300 Series for Channels 14 to 83

Rhombic No. UHF200

"Double-Vee" No. UHF100



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world's largest manufacturer of tv antennas and accessories

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elements
The NEPCO Line—television's *new* "Master of the Elements"—now meets the pressing demand for *better* electronic equipment. This complete line of *quality* TV Antennas, Mounting Accessories and Wire represents more built-in ruggedness than any now known—proves that *only the best meets the test of time!*
See the Nepco Line today. Examine its radically *new* design and construction. Prove to yourself that there's nothing finer on the market today—that it's the best by far at any price. Backed by the world's largest producer of electrical "roughing-in" materials, the Nepco Line carries National Electric's guarantee of quality, engineering and research. You can specify and install it with *complete* confidence of *long-life* installations and customer satisfaction. Write for details now.
THE NEPCO LINE

BAROMETER of the PARTS INDUSTRY

During December, 64 of the leading 400 manufacturers of Radio-Television-Electronic parts and equipment made changes in their lines. Actually there was an increase in "change activity" as compared to November.

In price revisions by the number of manufacturers and products affected, the following summary illustrates the comparative trend for the months of November and December.

	No. of Manufacturers	
	November	December
Increased prices	16	18
Decreased prices	7	10

	No. of Products	
	November	December
Increased prices	204	265
Decreased prices	136	88

For a summary of the most active product categories, see the following table:

Product Group	Increased Prices		Decreased Prices		New Products		Discontinued Products	
	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products	No. of Mfrs.	No. of Products
Antennas & Access.	6	58*	4	37**	15	167*	7	112*
Capacitors	1	37*	0	0	4	723*	0	0
Controls & Resistors	1	1*	0	0	6	379*	2	131*
Sound & Audio Prod.	2	7**	2	23*	9	88*	7	16**
Test Equipment	1	1**	0	0	6	16*	2	5*
Transformers	1	2**	1	1*	4	154*	1	9**
Tubes	6	159*	3	7*	9	41**	6	116*
Wire & Cable	0	0**	0	0**	1	5**	0	0

* Increase over November
** Decrease from November

* Increase over November
** Decrease from November

Comment: With more manufacturers reporting changes for this period, a continued emphasis is being placed on the introduction of new products, especially by manufacturers of antennas, capacitors and controls. Also evident is the continued tendency toward increased prices by the leading TV tube manufacturers.

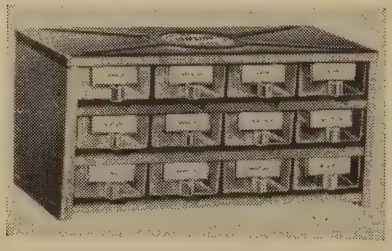
This data is prepared by the staff of United Catalog Publishers, Inc., 110 Lafayette Street, New York, publishers of RADIO'S MASTER, the Official Buying Guide of the Parts Industry.

Merchandising and Promotion

RCA Victor Tube Department, Harrison, N. J., launched a promotion campaign to help battery dealers capitalize on the replacement market anticipated

by the introduction of its new batteries for personal portable radios. The campaign includes window streamers, counter cards, and a battery display stand.

Astron Corp., East Newark, N. J., has built a sales promotion program around its new plastic-metal capacitor storage



kit. The *Jiffy-Kit* stores capacitors in clear metal-housed plastic drawers with identification labels. The kit, containing 113 capacitors, is being offered at a special price during the company's get-acquainted campaign.

Cornell-Dubilier Electric Corp., South Plainfield, N. J., is releasing free win-

dow streamers and envelope stuffers to service technicians through its distributors to promote sales of its antenna rotor.

Webster Electric Co., Racine, Wis., designed a new container for its line of

replacement cartridges. The new tenite *Jewel-Case* protects the cartridges and may be reused as a cigarette box or as a container for odds and ends in the shop, home, or office.

Merit Coil & Transformer Co., Chicago, held a series of meetings for dis-

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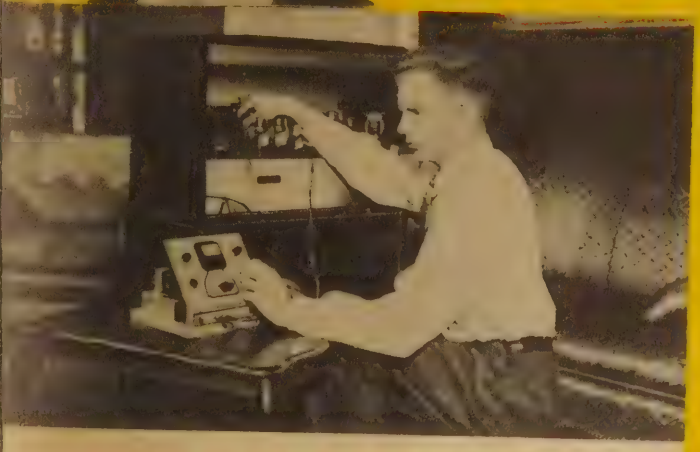
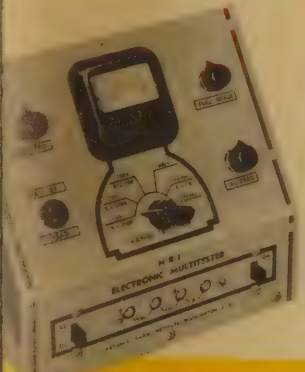
for Good Pay Jobs, Success in RADIO-TELEVISION



YOU LEARN SERVICING

by practicing with equipment I furnish



You build valuable Multitester (at left) as part of my Servicing Course. You use it to make many tests, get practical experience, make EXTRA money fixing neighbors' radios in spare time. Many of my students earn $5, $10 a week extra while learning. I send you many other kits too. You build a modern Radio. You build many circuits common to Radio and Television. All equipment is yours to keep. Read about and see other equipment in my free book. Mail card below.

YOU LEARN COMMUNICATIONS

by practicing with equipment I furnish

As part of my Communications Course I send you kits of parts to build the low power broadcasting transmitter shown at right and many other circuits common to Radio and Television. You use this equipment to get practical experience putting a station "on the air," performing procedures demanded of Broadcast Station operators. I train you for FCC Commercial Operator's License. Mail Card for Sample Lesson and 64-Page Book. FREE!

There are Good Jobs, Good Pay, Success in Radio-TV! SEE OTHER SIDE

TELEVISION is Today's Good Job Maker

951 over 15,000,000 homes had Television sets, e are being sold every day. 108 TV stations are ady operating, over 1800 are now authorized and ıy hundreds are expected to be on the air in). This means new jobs, more jobs and better for trained men. The time to act is NOW! Start ning Radio-Television servicing or communica- s. Want to get ahead? America's fast growing istry offers good pay, a bright future and rity. Cut out and mail card now. J. E. Smith, ident, National Radio Institute, Washington, D.C.

CUT OUT AND MAIL THIS CARD NOW

Sample Lesson & 64-Page Book

Both FREE

This card entitles you to Actual Lesson on Servicing, shows how you learn Radio-Television at home. You'll also receive my 64-Page Book, "How to Be a Success in Radio-Television." Mail card now!

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National Radio Institute, Washington 9, D.C.

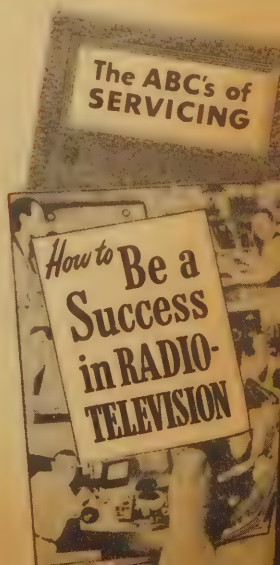
Mail me Lesson and Book, "How to Be a Success in Radio-Television." (No Salesman will call. Please write plainly.)

NAME.....AGE.....

ADDRESS.....

CITY.....ZONE....STATE.....

A B C



Train at Home to Jump Your Pay as a RADIO-TV Technician

There's a Bright Future for You in America's Fast Growing Industry

Do you want good pay, a job with a bright future, security? Would you like to have a profitable business of your own? If so, find out how you can realize your ambition in the fast growing RADIO-TELEVISION industry. Even without Television, the industry is bigger than ever before. 105 million home and auto radios, 2900 Radio Broadcasting Stations, 108 TV Stations with 1800 more now authorized. Expanding use of Aviation and Police Radio, Micro-Wave Relay, Two-Way Radio for buses, taxis, etc., are making opportunities for Servicing and Communications Technicians and FCC Licensed Operators.

NRI Training Can Lead to Jobs Like These in RADIO-TELEVISION

BROADCASTING
Chief Technician
Chief Operator
Power Monitor
Recording Operator
Remote Control Operator

SERVICING
Home and Auto Radios
P.A. Systems
Television Receivers
Electronic Controls
FM Radios

IN RADIO PLANTS
Design Assistant
Transmitter Design Technician
Service Manager
Tester
Serviceman
Research Assistant

SHIP AND HARBOR RADIO
Chief Operator
Assistant Operator
Radiotelephone Operator

GOVERNMENT RADIO
Operator in Army, Navy, Marine Corps, Coast Guard
Forestry Service Dispatcher
Airways Radio Operator

AVIATION RADIO
Plane Radio Operator
Transmitter Technician
Receiver Technician
Airport Transmitter Operator

TELEVISION
Pick-up Operator
Voice Transmitter Operator
Television Technician
Remote Control Operator
Service and Maintenance Technician

POLICE RADIO
Transmitter Operator
Receiver Serviceman

You Learn by Practicing with Kits I Furnish

With both my Servicing Course and my NEW Communications Course I send you many Valuable Kits of Parts. They "bring to life" theory you learn in my illustrated texts. Mail card for my big 64-page book. It shows photos of equipment you build from kits I send.

My Training Includes Television

Both my Servicing and Communications Courses include lessons on TV principles. You get practical experience by working on circuits common to both Radio and Television. My graduates are filling jobs, making good money in both Radio and Television. Remember, the way to a successful career in Television is through experience in Radio.

Send NOW for 2 Books FREE
Mail the Postage-Free Card NOW!

What will YOU be doing one year from today . . . will you be on your way toward a good job of your own in a Radio and Television service shop or business? Decide now that you are going to know more and earn more! ACT NOW! Take the important first step to a career and security. Send the postage-free card now for my FREE DOUBLE OFFER. You get Actual Servicing Lesson. Also my 64-page book, "How to Be a Success in Radio-Television." Read what my graduates are doing, earning; see equipment you practice with at home. Mail card now. J. E. SMITH, President, National Radio Institute, Washington 9, D.C. Our 39th year.

J. E. Smith, *President*
National Radio Institute

The men whose letters are published below were not born successful. At one time they were doing exactly as you are doing now . . . reading my ad! But they acted. They decided they would know more . . . so they could earn more! They acted! Mail the card now for my 2 books FREE.

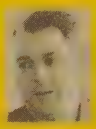
I TRAINED THESE MEN

Handicapped but Successful

"I am now Chief Engineer at WHAW. My left hand is off at the wrist. A man can do . . . if he wants to." R. J. Bailey, Weston, W. Va.

$10 a Week In Spare Time

"Before finishing, earned as much as $ a week in Radio servi ing, in my spare time recommend NRI". J. Petruff, Miami, Fl



Control Operator, Station WEAN

"I received my license and worked on ships. Now with WEAN as control operator. NRI course is complete." R. Arnold, Rumford, R. I.

Trained Men Mak Money In TV

"I am now servici Television. Your cour enabled me to rep TV receivers witho any trouble." Currier, Fair Haven,

Has Growing Business

"Am becoming expert Teletrician as well as Radiotrician. Without your course this would be impossible." P. Brogan, Louisville, Ky.

Got First Job Thru NRI

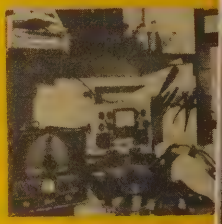
"My first job was w KDLR. Now Ch Engr. of Radio Equ ment for Police Fire Dept." T. Nort Hamilton, Ohio.

Find Out What RADIO-TV Offers Y

SAMPLE LESSON and 64-PAGE BOO Both FREE

Cut out and mail postage-free card toda

Make Extra Money While Learni



Keep your job while training. Many NRI students make $5, $10 and more a week extra fixing neighbors' Radios in spare time while learning. I start sending you special booklets that show you how to service sets the day you enroll. Multitester you build with parts I furnish helps discover and correct Radio troubles.

Want Your Own Business?

Many N.R.I. trained men start their own business with capital earned in spare time. Let me show you how you can be your own boss . . . Robert Dohmen, New Prague, Minn., (whose store is shown at right) says, "Am now tied in with two television outfits and do warranty work for dealers. Often fall back to N.R.I. textbooks for information on installing Television sets."

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Permit No. 20-R
(Sec. 34.9, P.L. & R.)
Washington, D.C.

BUSINESS REPLY CARD
No Postage Stamp Necessary If Mailed In The United States

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RECORD COMPENSATOR

"Hit of the New York Audio Fair"

LOW COST

SINGLE HOLE MOUNTING

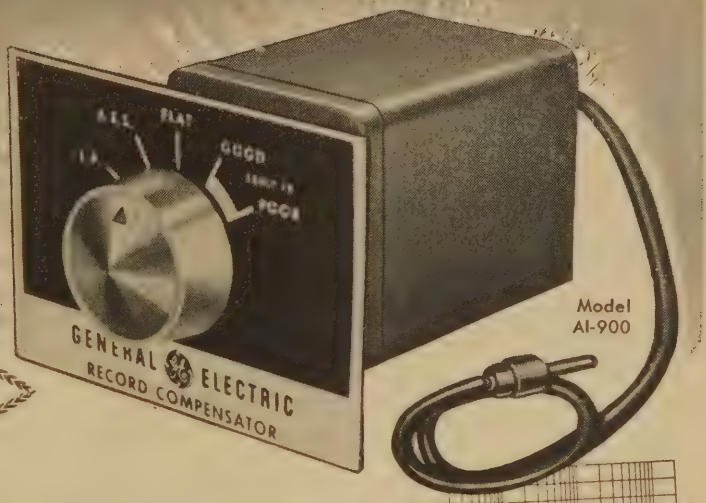
NEW LIFE FOR OLD RECORDS

EFFECTS FLAT RESPONSE

ADJUSTABLE PLAY BACK

MOUNTS IN ANY POSITION

1878 75 1953 YEARS OF ELECTRICAL PROGRESS



Model AI-900

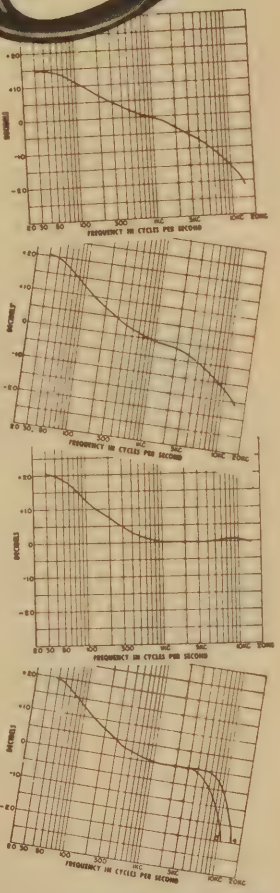
LP POSITION. The LP (Long Playing) playback response is intended basically for use with Columbia 33⅓ RPM recordings and modern Columbia 78 RPM shellac pressings. This position is used with any record having the LP recording characteristic.

AES POSITION. The AES (Audio Engineering Society) playback response has been proposed as a compromise response for all modern recordings. It has somewhat greater bass (below 100 cps) and treble response than the LP curve, and may be used in preference to the LP when such increased response is desired. It may be used to advantage with RCA 33, 45, and 78 RPM recordings, and with many other recent recordings.

FLAT POSITION. The flat position has no roll-off or attenuation of response beyond 1000 cps, which results in maximum high frequency response. Records having low background noise and distortion may be reproduced in this position with maximum brilliance. This position has no effect on the circuit, and the corresponding curve is therefore the response curve of the preamplifier and G.E. cartridge (with no cartridge loading resistor) based on constant stylus velocity.

GOOD (early 78). This position is intended for records having a noticeable amount of high frequency distortion or where the background noise is excessive and composed of frequencies higher than those recorded. It is particularly useful for 78 RPM shellac pressings that are in good condition. Brilliance is obtained through the useful portion of the response with sharp attenuation occurring at all frequencies beyond 7500 cps.

POOR (early 78). This position is intended for early 78 RPM shellac records having limited high frequency response and a high noise level. Moderately sharp attenuation occurs at all frequencies above 4000 cps.



SEND FOR THIS NEW FOLDER...

General Electric Company, Section 4523
Electronics Park, Syracuse, N. Y.

Please send me a copy of your Record Compensator ERP-24.

NAME.....

ADDRESS.....

CITY.....STATE.....

GENERAL ELECTRIC

SERVICE TECHNICIANS

What was your most unusual service case? Not necessarily the most difficult one, but the one you will remember longest, either because of the problem itself or because of other conditions surrounding the job. If the experience was interesting to you, it probably will be to other readers of RADIO-ELECTRONICS. We will pay $10 for each "My Most Unusual Service Job" item we consider outstanding enough to publish in this magazine. If the item is striking enough or carries sufficient technical information to be worth more than $10 in our opinion, it will be paid for at our regular space rates. Address your stories to

Unusual Service Job
RADIO-ELECTRONICS
25 West Broadway New York 7, N. Y.

tributors and service technicians on high-voltage and deflection problems. Sales manager Bill Barron and sales engineer Chet Jur spoke at the meetings.

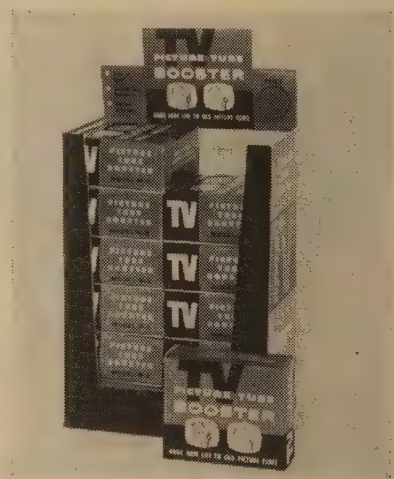
Jensen Manufacturing Co., Chicago, has distributed almost 700,000 pieces of literature describing high-fidelity reproduction and loudspeakers, according to Ralph Glover, Jensen production manager. This total does not include the company's technical monographs and data sheets.

Hallicrafters Co., Chicago, held a promotion on its line of short-wave radios with the give-away of a $5 full-color world globe with the purchase of a Hallicrafters Continental or other short-wave radio, according to John S. Mahoney, director of advertising.

Grayburne Corp., New York City, has prepared a counter merchandiser for its

new chemical solvent, *Q-T*, which quiets and preserves radio and TV controls and contacts.

Workman TV, Inc., Teaneck, N. J., manufacturer of cathode-ray tube



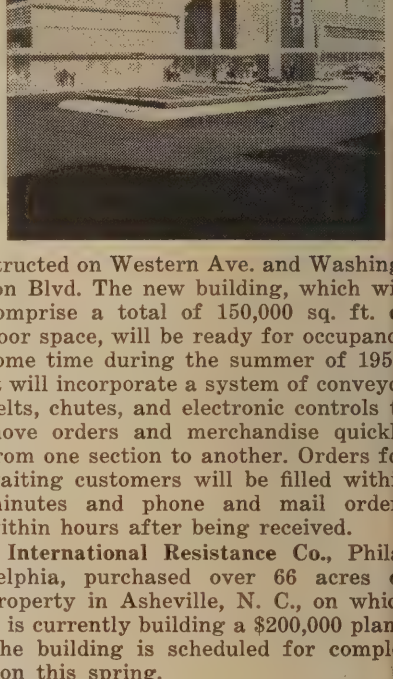
boosters, is distributing a new counter display which contains 12 individually boxed tube boosters.

RCA Tube Department, Harrison, N. J., issued the 1953 edition of its yearly pocket reference and calendar notebook containing handy technical reference material on RCA tubes, components, test equipment, batteries, and miniature lamps. Other features of the book include maps, a diary, and memo, address and telephone number sections.

Jensen Industries, Inc., Chicago, released a colorful diamond needle folder, "Your Favorite Phonograph Records' 'Best Friends.'"

New Plants and Expansions

Allied Radio Corp., Chicago, national distributors of electronic parts and equipment, reports rapid progress on its new $2,000,000 building being con-



structed on Western Ave. and Washington Blvd. The new building, which will comprise a total of 150,000 sq. ft. of floor space, will be ready for occupancy some time during the summer of 1953. It will incorporate a system of conveyor belts, chutes, and electronic controls to move orders and merchandise quickly from one section to another. Orders for waiting customers will be filled within minutes and phone and mail orders within hours after being received.

International Resistance Co., Philadelphia, purchased over 66 acres of property in Asheville, N. C., on which it is currently building a $200,000 plant. The building is scheduled for completion this spring.

Ward Products Corp., Cleveland, announced that its sales offices and the general offices of The Gabriel Co., its parent company, are now located at 1148 Euclid Ave. The Ward purchasing and factory offices remain in Ashtabula, Ohio.

Electro-Voice, Inc., Buchanan, Mich., purchased the Radio Manufacturing Engineers, Inc. (RME), which manufactures amateur communications receivers, converters, and accessories. RME will remain under the present management of E. G. Shalkhauser and Russ Planck, and will continue to conduct business from its Peoria, Ill. offices.

Cornell-Dubilier Electric Corp., South Plainfield, N. J., purchased a 27-acre tract of land for the erection of a new plant at Sanford, N. C. The company now operates 11 plants in 6 states.

The Neal Electronic Co., Huntsville, Ala., manufacturer of the *Fringe-Beam* all-channel TV antenna, moved to a new factory at 505 Seminole Drive.

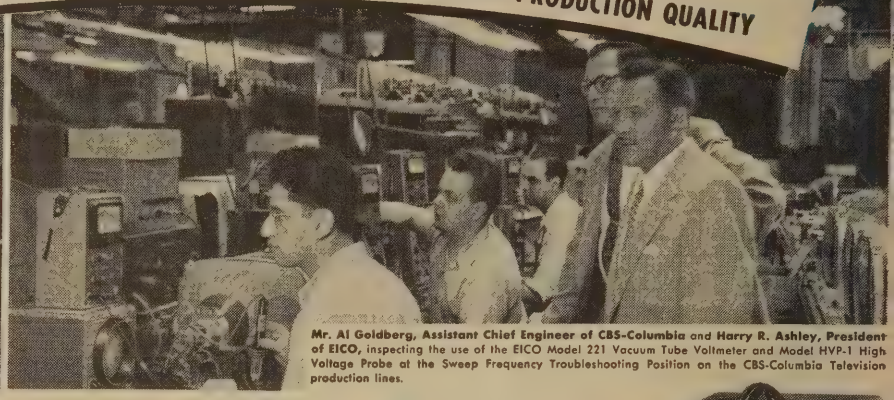
Simpson Electric Co. has expanded its operations for the third time since World War II. The company is doubling its present Chicago plant space.

National Union Radio Corp. moved its administrative and home offices to Hatboro, Pa. The Research Division will carry on expanded research activity at the present plant in Orange, N. J.

Hytron Radio & Electronics Co. moved its Eastern sales office to quarters at 3 Green St., Newark, N. J. EN

EICO TEST INSTRUMENTS GUARDS CBS Columbia HIGH STANDARDS OF TELEVISION PRODUCTION QUALITY

In the CBS-Columbia design laboratories, Al Goldberg takes some important readings with the EICO Model 221 Vacuum Tube Voltmeter and Model 555 Multimeter, as Harry R. Ashley looks on.



Mr. Al Goldberg, Assistant Chief Engineer of CBS-Columbia and **Harry R. Ashley, President of EICO,** inspecting the use of the EICO Model 221 Vacuum Tube Voltmeter and Model HVP-1 High Voltage Probe at the Sweep Frequency Troubleshooting Position on the CBS-Columbia Television production lines.

KITS-Wired Instruments

For Laboratory Precision at Lowest Cost— the Leaders Look to EICO!

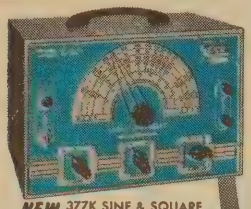
WHY does CBS-Columbia, Inc., one of America's great headline-makers in Television set production, use EICO Test Instruments on both its new Television production lines and in its design laboratories?

BECAUSE like Emerson, Tele-King, Teletone, Majestic, and many another famous TV manufacturer coast to coast, CBS-Columbia knows that

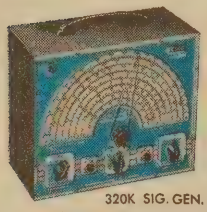
ONLY EICO TEST EQUIPMENT DELIVERS ALL 10 EICONOMICAL FEATURES

1. Laboratory Precision
2. Lowest Cost
3. Lifetime Dependability
4. Speedy Operation
5. Rugged Construction
6. Quality Components
7. Latest Engineering
8. Super-Simplified Assembly and Use Instructions
9. Laboratory-Styled Appearance
10. Exclusive EICO Make-Good Guarantee

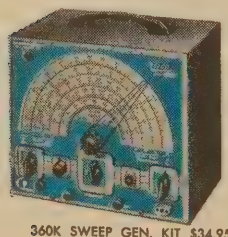
Before You buy any higher-priced equipment, be sure You look at the *EICO* line—*in Wired as well as Kit form!* Each EICO product is jam-packed with unbelievable value. YOU be the judge—*compare,* see *EICO instruments today* — in stock at your local jobber — and **SAVE 50%!** For specifications of the entire EICO line, write for latest EICO Catalog C-2. **FOLLOW THE LEADERS . . . INSIST ON EICO!**



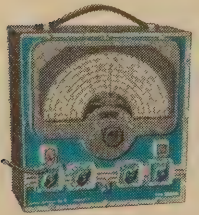
NEW 377K SINE & SQUARE WAVE AUDIO GEN. KIT $31.95. WIRED $49.95



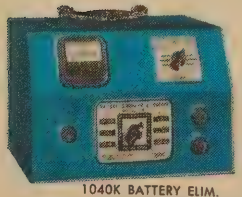
320K SIG. GEN. KIT $19.95. WIRED $29.95
322K SIG. GEN. KIT $23.95. WIRED $34.95



360K SWEEP GEN. KIT $34.95 WIRED $49.95



315K DELUXE SIG. GEN. KIT $39.95 WIRED $59.95



1040K BATTERY ELIM. KIT $25.95 WIRED $34.95

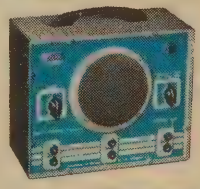
RES. DECADE BOX KIT $19.95 WIRED $24.95

NEW 536K MULTIMETER KIT $12.90. WIRED $14.90. 1000 OHMS/VOLT

950K R-C BRIDGE & R-C-L COMP. KIT $19.95 WIRED $29.95

NEW 214K VTVM KIT $34.95. WIRED $54.95. 7½" METER

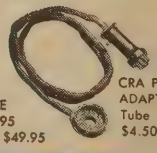
NEW 565K MULTIMETER KIT $24.95. WIRED $29.95. 20,000 OHMS/VOLT



145K SIG. TRACER KIT $19.95 WIRED $28.95

625K TUBE TESTER KIT $34.95 WIRED $49.95

221K VTVM KIT $25.95 WIRED $49.95



CRA PIX TUBE ADAPTOR for Tube Tester $4.50

425K 5" PUSH-PULL SCOPE KIT $44.95. WIRED $79.95

HIGH VOLTAGE PROBE $6.95

AMERICA'S GREATEST INSTRUMENT VALUES BEAR THE NAME—

EICO Reg. U.S. Pat. Off.

ELECTRONIC INSTRUMENT CO., INC.
84 Withers Street, Brooklyn 11, N. Y.

Prices 5% higher on West Coast. Due to unstable conditions prices and specifications are subject to change without notice.

TRANSISTOR TRANSITION

. . . The transistor will soon be ready to transform the industry . . .

By HUGO GERNSBACK

THE evolutionary path of radio science is dotted with a number of milestones. Earliest known to most of us is the spark-gap transmitter and coherer of the "wireless" days, with which the first commercial signals were sent and received. The coherer was soon replaced by the crystal detector and other rectifying devices, while the spark transmitter was partly supplanted by the arc and alternator.

When the vacuum tube made its triumphant and revolutionary entrance into the field—expanding radio to a degree that even its boldest protagonists had never envisioned—all these earlier devices were doomed. First in receivers, and a little later in transmitters, the vacuum tube became supreme, and from a little after 1907 till the present, has dominated the industry.

Even when television burst upon the scene—bringing still another new era with it—the vacuum tube still remained as the most important component of television transmitters and receivers, second only to the cathode-ray picture tube (itself a vacuum tube of special type).

With the recent advent of the transistor, the vacuum tubes will in the foreseeable future be in eclipse, although they will always be with us. Transistors will never completely supplant the ubiquitous electron tube.

The time will soon arrive when the transistor will begin to revolutionize the radio-electronic industry. This will be sooner than was expected, even by its inventors. Shortly after the advent of the transistor, handmade specimens sold around $18.00 apiece. Very recently the price was around $8.00. This, naturally, is but a beginning. It is certain that transistors, when finally mass-produced, will sell at a lower price than present-day vacuum tubes.

For this reason, all of us in the industry should ponder how the transistor will affect and indeed revolutionize most branches of radio-electronics.

No one doubts today that radio and television receivers will in the future be transistor-equipped; indeed, the trend is certain to be irresistible for many reasons. Not requiring any heating elements, there will be a large saving in electric current. The size of radio and television sets will shrink considerably. So will their weight, and, most important of all, much less labor will be required in manufacturing receivers. Thus they can be sold at a lower price than at the present time.

Transistors should last for a long time because there is nothing to wear out and there probably will be fewer replacements. Radio as well as television sets will not heat up anywhere as much as our present-day ones. Consequently, such parts as resistors and capacitors will not be so apt to become defective on account of heat effects. In addition to using transistors, appliquéd circuits—the so-called printed circuits—are also certain to be used in the near future, making for still greater price reductions of such receivers. So much for the present-day type of set.

However, we will have many other more important new devices in the future. I refer to the *miniradios*, which could not be manufactured economically with vacuum tubes. Now with transistors, drawing minute current from low-voltage batteries, radios the size of a match box and smaller, are certain to be made in the future. The public has always shown a great deal of interest in *personal* pocket or handbag radios. Mass-produced, they can be sold at a very reasonable price and will fulfill a distinct need. As our civilization becomes more complex, people, no matter where they are, want to obtain instant news, time and weather reports, as well as other special services. These, the stations of the future will provide. Such small pocket radios need merely be held up to the ear to receive local radio stations instantly.

Other miniradios, the size of fountain pens, already predicted by the writer in the April, 1946 issue of this magazine, will become commonplace. The same is true of watch-size and wristwatch radios, as well as other miniature types of personal receivers. Millions will be sold.

The transistor television receiver is no longer a future prediction. Very recently the Radio Corporation of America engineered a portable television receiver which was shown to the press last November. Admittedly a laboratory stunt—to demonstrate what could be accomplished with transistors—this receiver had no vacuum tubes, but it did have the usual type of cathode-ray television picture tube.

This brings up the question: Will it ever be possible to have a sort of transistor picture tube? We believe this belongs distinctly in the realm of future possibilities. If this is doubted, all one has to do is study the human eye, which, like the transistor, works on a minimal amount of electric current. The processes of seeing, as scientists maintain, is electro-chemical. It would seem quite possible that in the future some such a device may be produced. Its dimensions will probably be much smaller than the present type of cathode ray tube. It may not be larger in any dimension than 2 inches. This means that it will have to be a projection-type device, throwing the image or picture onto a small portable screen that can be rolled up or folded when one desires to view a program.

Where does the service technician fit into this complex future industry? To begin with, *all* technical progress is gradual. Millions of present-day radio and television sets will still have to be serviced for several decades to come. Future transistor sets will not require anywhere near as much servicing as do present-day receivers. On the other hand, it is certain that there will be between three to five times as many radios and televisors as we have now. Consequently, even if the percentage of breakdown is less, the service technicians will still have their hands full trying to give adequate service in the future. *As a matter of fact, there will have to be many more thousands of service technicians twenty years hence than we have at present, if they are to keep up with the work.*

The service technician also will have to change his thinking and his techniques when it comes to servicing transistor receivers. He will have to completely re-educate himself to the new trend, just as he had to reorient himself when television arrived on the scene. In this he will be benefited enormously. All in all, the service technician of the future will be a far better and more precise individual than he ever was before and we are certain his earning powers will be greatly enhanced too.

Good employee and customer relations plus good business practises are the secrets of this New York service shop

TV SERVICE CAN BE

By JULIETTE DRUT*

AN efficient television service company depends on three things: good organization, good men, and good parts. Since TV service deals primarily with labor and parts, there is no reason why we can't earn a decent profit in this business. But if we continually cut our own prices with ruthless competition, we wind up with incompetent labor, poor organization, and inferior parts. The TV service operator has it in his power to keep profit at a decent level, give excellent service, and use only the best of materials. Unfortunately—as in the old radio repair days—he is not doing this, but by cutthroat methods is preparing his own downfall and is being branded liar, thief, and cheat.

When I started my own company, I was determined to forget this kind of competition and try through honest service to give the consumer what I considered decent workmanship. By giving the customer prompt, honest, and efficient service and *by charging enough to permit me to do so*, I have been able to build up a business based on profit and good will.

A day at Rondel

The day begins at Rondel TV at 8:30 am. Our shop foreman, who is an engineer, holds class with the men and discusses new chassis, new modifications, and new phases in TV, as well as anything else that the men want to know. There is also a question-and-answer period. These informal classes last about a half-hour and we arrange work schedules so that every man can attend at least three times a week. In this way our men miss nothing. They are well informed and equipped to do a better job.

Because we are open 24 hours a day, our men are rotated during the week. Some start at 9 am, others at noon, and others at 3 pm. This enables my company to service sets right up to 11 at night. Although the office closes at 6 pm, we have a telephone-answering service that picks up our telephone wires after the office closes. Then I call the answering service every hour for messages, and dispatch the calls to our men in the field. Calls received late in the evening are held until morning.

When the men finish their work, they bring in their reports *and their used parts*. The reports are carefully checked by me, and if there is any additional work to be done, such as an antenna call or a follow-up on a part, we get in touch with the customer and make a new appointment. This makes the customer feel we are "on the ball".

The chassis that come to the shop are placed on the section of shelves marked "For Repair." When a benchman places a set on the bench, he must check it over very carefully. Then he gives the office his estimate on the shop repair. The customer is called and told what we think is needed in parts and what, approximately, the price will be. When we get consent to go ahead with the repair, we begin work immediately. We fix not only the trouble that the set came in for, but anything else that we may anticipate or suspect.

The completed set is then given a heat run. I try to see to it that there are very few callbacks, because the callback is the greatest threat to your profit. The heat run enables our men to watch the set carefully and make sure that nothing else shows up.

When our shop foreman is satisfied with the performance of the set, it is placed on the section of the shelves marked "Completed." The office calls the customer, makes an appointment for delivery, and the set is then returned with a bill that has the complete breakdown—cost of parts and of labor—on it. The customer then has the list of parts used in the set and knows for what he is paying. I find this to be an excellent practice, because if anything should happen to the set a month or so later, it may be a completely new trouble. By having this itemized bill the customer can assure himself that he is not paying for the same thing twice.

The returned parts are carefully checked, too. Those that have a warranty are marked for replacement and are replaced by our parts man. He makes sure that the parts that are in date are exchanged or placed on back order, and sees to it that there are always enough of every kind of part on hand. He also checks the technicians' written reports to see what follow-up of parts are needed, and orders immediately any part that is not in stock.

The completed report is then filed under the customer's name and address if the set is under contract, or alphabetically and by the month if it is for a C.O.D. call. These reports are easily accessible should I have any need to check them within the next year.

The service personnel

I know that a man who is skilled deserves a living wage. I pay my men $95 a week. Broken down, that is $80 a week and $3 a day for the man's car. The man works a 5-day, 40-hour week. He is given eight calls a day and spends about one hour on a call. I arrange the calls so that he doesn't have much travel time, thereby allowing him more time with the sets.

Once a month I take our men out to dinner. This is always a treat for all of us. I encourage them to speak openly, to tell of their pet peeves. I am a good listener. The man may discuss his home life or anything else he wishes to speak of. This builds excellent employer-employee relations. The men do not hesitate to speak about the running of the business and very often I find their criticisms most constructive.

Our men have complete health coverage. They are enrolled in the Health Insurance Plan for which they pay nothing, since the company absorbs the entire cost rather than just half as do many companies. A man working for Rondel does not worry about the health needs of his family and has no fear of doctor bills.

All this takes money. Therefore we have carefully tabulated our costs and concluded that $5 for the first hour and $3 for each additional half-hour is a fair price for a service call. I did this by taking one man's earnings—$95 a week—added $7.60 a week for insurance and taxes, and $12.35 a week for overhead (these costs were previously worked out). This brought the figure to $114.95—our cost for a man. I then divided that sum by 40 working hours and the figure is $2.87 per call—our cost. On a wholesale basis—because the dealer feeds us so many calls a day—we are able to charge $4.50 a call. But for retail calls, $5 is a fair price.

The service technician who works from his home and feels that he has no overhead still has his own labor to consider. He also has his car insurance and his telephone costs, and his own personal insurance. He pays about $250 a year for car insurance, $150 a year for life insurance, and at least $120 a year for telephone (triple that if he uses an answering service). Altogether that is $520 for his own personal overhead, or $10.40 a week. Add $95 for labor and car and you have a total of $105.40 which is not much less than our weekly cost of $114.95.

Looking at these figures, how can any so-called service technician charge only $3 for a call? Especially when we consider that he is likely to use up more travel time than our technicians do, because he hasn't the opportunity to bunch each day's calls in one area as we can by operating on a volume basis. Any

* Proprietor, Rondel TV, Bronx, N. Y.

SUCCESSFUL

service technician who charges $3 or less a call is certainly cheating himself of his own labor, and that's foolish. Only by keeping his price at a fair level can he give honest and sincere service. And by requiring an equitable price which enables him to give honest value, he helps to combat those cutthroat organizations that offer "bargains" and give only a very bad name to an industry that doesn't deserve it.

Check list for management

A few words on running a TV service company efficiently and successfully:

1. *Route the service calls as closely as you can.* You'll save time and gas, besides the wear and tear on the car. It will also enable the technician to spend more time on each job.

2. Try to buy in larger quantities and don't hesitate to shop for prices. Very often you'll find that one distributor has an excellent special on tubes for a week. Another will have a special on wire, and so on. If you're too small to buy in quantity, try to buy co-operatively with a few other service outfits like yourself. It's important to save wherever you can by purchasing in *quantity*, but do not skimp on *quality.*

3. *Try to keep your telephone calls under control.* The office help can make many unnecessary calls unless you watch carefully. If your office people are well briefed, they can explain to the person who calls in for service that it is very difficult to tell just when the service technician will call because routing does not take place until 5 pm that day.

However, if they want to know whether it will be morning or afternoon or approximately at what hour, we suggest that they call at 9:30 am the following day and we will be able to give them the information.

4. *Try to keep a careful check on parts.* I think this is most important, for this business revolves around parts and labor. For every fresh tube the technician gets, he must later return a used tube, or pay for the one he received. Tube kits should be checked *every day* before a man starts out and every evening when he checks in. Of course, you can't be sure that the used tube he returns didn't come out of a junk set rather than the customer's set. A certain amount of this will happen at times. But you can eliminate much of it by spot-checking to determine if a man is where his schedule calls for him to be, or by calling, at random, several of the places he serviced during the previous week. Incidentally, here as elsewhere, *the good-will your men have toward you will show itself.*

Mrs. Drut and her secretary engaged in part of the day's work.

A large map of the area helps in planning daily itineraries.

5. Read your service technician's report carefully and note his comments. Also, try to send the last service report with each new call so that if a new man is handling the call he will know what has already been done to the set.

6. Above all, when hiring a new person for your firm, do not take it for granted that he or she knows how to handle the customer. *Make certain that he does,* by telling him exactly in what manner he should speak to customers and what you expect of him. When I hire a girl I never take it for granted that she knows what to say when dealing with customers on the telephone. I explain to her our operations in great detail and instruct her thoroughly before letting her take a single call. It is the same with the men.

Here is a list of the rules each service technician is expected to follow:

1. Try to refrain from smoking in customer's home; or else ask permission to smoke and request an ash tray.

2. Do not sit on light-colored chairs or upholstery.

3. Use a polishing cloth to rub out finger marks on cabinet.

4. Do not handle the set roughly in sight of customer.

5. Never "knock" the receiver you are installing or servicing. Let the customer believe that it is one of the best sets on the market.

6. Leave a business card.

7. Bring only essential tools into the home; no drills, a.c. cables, etc.

8. Explain the operation of the set carefully and patiently.

9. Impress the customer with your thorough knowledge of the problem.

10. Courtesy is the best policy.

And we of course tell our men that because they are going into people's homes they must be neatly dressed.

These things are all very important. Your telephone girls and service technicians are the ones who handle your customers directly, and if they are not trained in the way you want them to operate, they can bring you customer ill-will and loss of business.

I sincerely hope that those of you who have read through these lines have found something useful to you in them. I have tried to show you how Rondel TV is run. It is a good company and a successful one. May yours be, too! END

Brand-new vigor for aging sets with minor surgery and exact replacements

RESTORING PEAK

By WALLACE WANER

NOW that televiewers are getting receivers with 17-inch or larger picture tubes, they will not be trading in their sets as often as they did earlier 10- and 12-inch models. A time will come in the life of these newer receivers where routine tube and parts replacements will no longer restore their peak performance. This is because several circuits depend on critical parts values as well as voltages.

As resistors and capacitors age, their individual values may not be far enough off normal rating to impair circuit function, *but the cumulative effects of several slightly off-value parts will give inferior performance.* Under such conditions the horizontal-lock system, for instance, will have poor stability which is virtually impossible to correct even with new tubes and careful adjustment of hold, phase, and frequency controls. The trouble may not be readily apparent, however, for each voltage would be *almost* normal, and resistors and capacitors *when checked individually* do not seem far enough off value to need replacement.

When receivers that have been in service for several years do not respond to normal routine servicing, the technician will have to resort to circuit overhaul. If the set has had a really hard life, *complete* overhaul may be necessary. The cost to the customer will run much higher than ordinary service jobs, but the final result will be worth the expense. Performance can be made close to that of a new receiver. At the same time, the cost will be only a fraction of the value of the set (or the price of a new one).

Overhaul doesn't necessarily mean wholesale replacement of all parts. The technician who knows which components are critical and likely to cause trouble will be able to hold down the charge to reasonable proportions. General symptoms of defects (as with routine servicing) will indicate the circuits that need the most work. These generally include the sweep circuits and the tuner, with less work necessary on other circuits as indicated by the symptoms of the individual receiver.

All tubes, of course, should first be checked and substandard ones replaced. This includes the low-voltage rectifiers, whether vacuum tubes or selenium units. Before going further, all filter capacitors should be checked and replaced if their leakage loads down the power supply and drops the voltage output below normal.

Once tubes and power supply are known to be good, receiver performance should again be evaluated. A more correct estimate can now be made because circuit behavior will no longer be influenced by the cumulative effect of a number of weak tubes or low screen or plate voltages.

The circuits which are generally most troublesome and demand priority over others will follow, with special attention to the important points to keep in mind when undertaking overhaul.

Horizontal sweep circuits

The horizontal sweep system of a television receiver is always a source of trouble. When parts age, the cumulative effect of various off-value components has a serious effect on over-all performance. This applies to both the Synchrolock and Synchroguide systems as well as the phase detector.

Fig. 1 shows a typical Synchrolock horizontal a.f.c. circuit such as used in the original RCA 630. Because of its good noise immunity and stability, it is still found in many modern receivers.

In this circuit the sync pulses are compared in a discriminator with the sine wave produced by the horizontal oscillator. The discriminator produces a correction voltage when the horizontal oscillator drifts. The correction voltage is applied to a reactance type oscillator control tube, which corrects the frequency drift of the horizontal oscillator by altering the reactance of the tank.

Noise voltages and changes in sync amplitude that may come through the sync-separator circuits are applied equally and in the same polarity to both ends of the discriminator by the center-tap feed (terminal E). Both diodes conduct equally and develop indentical output voltages across the two 470,000-ohm load resistors. With the same rectified voltage at pins 1 and 5 of the 6AL5, the net noise voltage across the ends of the two load resistors is *zero.*

When this system has all new parts and tubes it is highly stable even at extreme settings of the horizontal hold control. The "pull-in" is excellent and when changing from one station to another, horizontal synchronization is established almost instantly. As tubes and parts age, the general performance gradually declines until, eventually, replacing single parts and tubes no longer gives satisfactory results, and a general overhaul is necessary.

Two fairly critical components are the 470,000-ohm resistors in the cathode circuits of the discriminator. Off values in these can unbalance the discriminator circuit so that one diode section conducts better than the other. If one re-

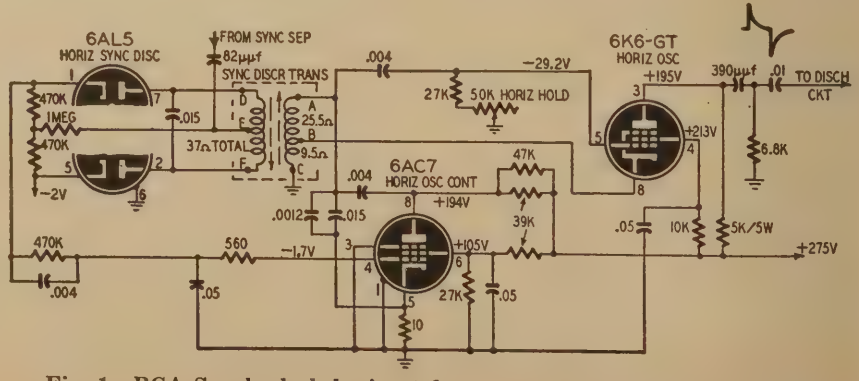


Fig. 1—RCA Synchrolock horizontal-sweep oscillator and a.f.c. circuit.

PERFORMANCE

sistor increases in value beyond the 10% tolerance rating while the other *decreases* in value, the difference can prevent good lock-in. These two resistors should be replaced with closely matched units when overhauling this circuit.

The range of control is governed by the condition of the 6AC7 control tube as well as the associated component parts. The .015-μf capacitor in parallel with .0012-μf unit is particularly important because a change in capacitance can upset the normal frequency to the point that the control tube may have difficulty making correction. The same holds true for the 27,000-ohm resistor in series with the hold control. An appreciable change in the value of this resistor can make the hold control ineffective or effective only at an extreme setting.

Some of the other capacitors in the oscillator hold-control circuit can also contribute to sync difficulty, though usually they will have no direct bearing on the frequency. The .004-μf capacitor in parallel with the 470,000-ohm resistor from the discriminator tube filters the 15,750-cycle ripple component from the d.c. correction voltage applied to the grid of the control tube. The .05-μf capacitor to ground in this filter network is also important for bypassing frequency components which would add a certain amount of ripple to the correction voltage.

The plate-load resistor of the horizontal control tube can also cause trouble by changing value through the heat of the plate current. The parallel 47,000-ohm and 39,000-ohm resistors to the plate of the horizontal control tube should be checked carefully. The tendency in composition resistors is for the resistance to increase with age and heat and this would reduce the plate voltage of the control tube. The same holds true for the 39,000-ohm screen resistor of the control tube. An increase in this resistor would lower the screen voltage, while an increase in the 27,000-ohm resistor to ground would reduce the "bleeder" action, and voltage instability at this point might contribute to poor synchronization. Check the 5,000-ohm oscillator plate resistor as well as the 10,000-ohm screen-dropping resistor. The .05-μf screen bypass capacitors on the control and oscillator tubes should also be replaced. Leakage here is common and increases the drain on the power supply besides reducing the screen voltages. *Open* capacitors at these points would decrease performance by allowing signal voltages to appear in the screen circuits.

The 390-μμf capacitor in the plate circuit of the oscillator and the 6,800-ohm resistor to ground form a differentiating network which filters out the low-frequency components of the pulse produced by the horizontal oscillator. The leading edge is retained for triggering the discharge tube. Both these components, and the .01-μf coupling capacitor to the next tube should be replaced.

After these critical components have been replaced the receiver should be given a performance check. It will probably be necessary to readjust or realign the entire horizontal-lock and sweep system. Follow the step-by-step procedures given in the service notes for the receiver. Check all voltages and any off values would indicate that additional checks and possible parts replacements are in order.

The RCA Synchroguide

The Synchroguide circuit shown in Fig. 2 is another popular horizontal-a.f.c. system. As with the Synchrolock, off-value resistors and capacitors have considerable influence on the stability of the system.

The Synchroguide oscillator is the blocking type, with a stabilizing resonant circuit (the 36-ohm winding C-D shunted by the .01-μf capacitor). The output from this circuit feeds the sawtooth-forming network. The drive to the horizontal output tube is controlled by the 40-370-μμf trimmer. This should be adjusted just below the point where left-hand stretch or center compression occurs. Off-value parts in the amplifier grid circuit can contribute to poor linearity, as well as improper drive. Too much drive can develop excessive currents in the flyback transformer which would tend to increase high voltage and thereby cause corona and arcing.

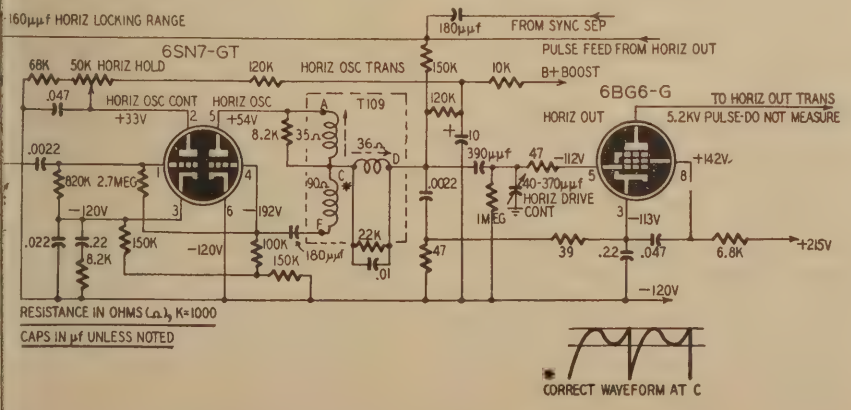


Fig. 2—Synchroguide horizontal oscillator-a.f.c., with normal output waveform.

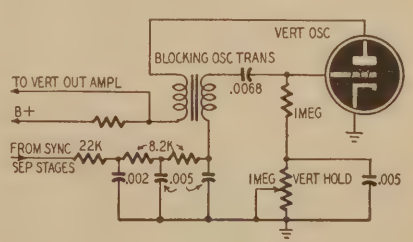


Fig. 3—Typical vertical blocking-oscillator circuit, with integrator network. Height control (not shown in the diagram) is generally in the B plus lead.

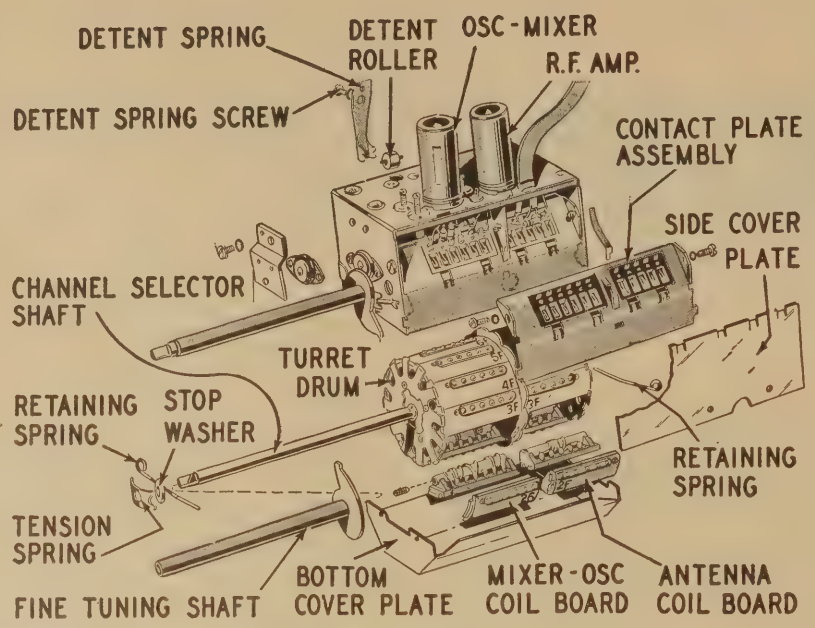


Fig. 4—Exploded view of Standard Coil turret-type tuner, showing check points. As in all switching devices, points most susceptible to wear are coil-segment contacts, fixed-contact tension, and detent mechanism. Bearings detent roller, and fine-tuning control may also require periodical cleaning and lubrication. Circuit overhaul hints are given in the text.

Excessive high voltage would tend to decrease picture size because the beam would have abnormally high velocity and be more difficult to sweep with the fields of the yoke. Insufficient drive will reduce the bias on the output tube, which may be damaged by excessive plate current. The capacitors and resistors in the cathode circuit of the oscillator-control tube are particularly important. They comprise the "anti-hunt" circuit, which prevents the control tube from overcorrecting the oscillator and minimizes the tendency to hunt the correct oscillator frequency. These resistors and capacitors should have the exact tolerances specified in the service notes for the receiver. Again, off-value resistors in the hold control circuit can affect the stability of the hold control or can cause the hold control to function only at an extreme setting. Close-tolerance resistors should be used here.

Like the Synchrolock circuit, the Synchroguide system can be checked after some of the critical components have been replaced. The circuit must be realigned after any component changes. If the receiver has had much use, the locking-range, as well as the frequency and phase adjustments in the oscillator transformer may have been changed to compensate for the normal drift caused by aging components. All these will have to be reset for proper functioning with new components.

The Synchroguide system will operate at peak performance *only* if an oscilloscope is used to make sure that the broad and narrow peaks of the waveform at terminal C of T109 are equal in amplitude. The scope must have a low-capacitance probe. The adjustment procedures are quite complex and the detailed step-by-step instructions given in the service notes should be followed carefully in order to obtain good noise immunity, pull-in, and sync stability. While many technicians boast that they can adjust a Synchroguide system without special equipment or step-by-step procedures, they invariably get inferior results. Reasonable stability can be achieved by merely adjusting the various controls until the picture locks in fairly well. Under these conditions, however, the system will be thrown out of sync easily by noise pulses and will not have the rapid pull-in obtained when it is operating at peak performance. At the same time, the hold-control range is critical when the system has not been properly adjusted.

All horizontal systems require close-tolerance parts and many components are temperature compensated. For this reason use factory replacement parts or equivalent parts recommended by the manufacturer. Using ordinary resistors and capacitors may cause considerable drift during warmup. The critical components are not the same in all lock systems and the exact replacement part for a specific receiver should be ascertained by reference to the service notes.

Vertical sweep circuits

The vertical sweep system is usually less complex than the horizontal system. In general, the same procedures hold for overhaul. Capacitors are more apt to give trouble than resistors, except for those resistors which carry considerable current. A typical vertical sweep oscillator is shown in Fig. 3. A low-pass filter (integrator) is used in virtually all vertical oscillator circuits. This consists of several resistors and capacitors which filter out high-frequency noise and interfering signals above the 60-cycle field rate. The capacitors also accumulate charges during the vertical-sync interval and when the charge potential reaches a sufficiently high value it fires the vertical oscillator. The stability as well as the interlace characteristics of the vertical sweep system depend on this simple integrator circuit. When troubles occur in the vertical system the three capacitors in the integrator circuit shown in Fig. 3 should be replaced. (Some integrator systems may have more or less than three capacitors.) The resistor usually cause no trouble because there is no d.c. flowing through them. However, off values will upset interlace and can cause slight sync instability on occasion. (Many sets now use printed circuit integrator assemblies which include both resistors and capacitors. Used as replacements, they make the technician's job easy.)

If the hold control works only at an extreme setting, the series resistor should be checked. In the circuit shown in Fig. 3, the 1-megohm resistor could be sufficiently off value to shift the range of the vertical hold control. The same holds true for the .0068-μf coupling capacitor in the grid circuit.

In feedback-type vertical circuits where one tube or triode section is part of the oscillator as well as the output amplifier, give special attention to the resistors and capacitors in the feedback network. Large-amplitude pulses across the output winding during the vertical retrace interval may break down the capacitors and increase the values of the series resistors.

In receivers with vertical-retrace blanking watch out for changed values in the coupling to the picture tube. Defects here can react on the vertical sweep as well as on the picture.

Another point to check carefully, especially where the vertical circuit operates from the boosted B plus line is the electrolytic decoupling capacitor at the B plus feed point. Even a slight amount of leakage here can reduce the efficiency of the entire set, especially the horizontal-sweep width and high-voltage circuits.

When foldover exists the coupling capacitor to the vertical output tube should be checked. For insufficient height check the B voltages to the vertical oscillator and output tube as well as the components in the vertical output-amplifier circuit. Again, replacement of critical parts is advisable during the overhauling process.

Tuner and antenna system

Tuners can cause considerable trouble through weak tubes and defective parts. In addition to this the tuner represents the only section of the receiver which has moving parts (except potentiometers, of course). For this reason troubles often develop in the station-changing mechanism.

As with other circuits, tubes should be changed first. The oscillator and mixer tubes are often combined in modern receivers. When the oscillator section is defective, drift is more pronounced and the fine-tuning control must be adjusted more frequently. Tunable hum and sound bars may also originate in the local oscillator. (A cathode-heater short will produce hum bars which are visible only when a station is tuned in.) Improper lead dress may cause troubles, as well as defective components or tubes.

Try several mixer-oscillator tubes to find one that does not upset the tuner tracking too much. The r.f. tube should also be replaced because a drop in emission will reduce the signal strength and the picture contrast. A decline in the signal-to-noise ratio would also mean more "snow" on weaker stations.

Mechanical elements in the tuner should also be checked. With most drum tuners (see Fig. 4) there is usually a spring clamp at each end that holds the drum in position. When these springs are loosened the drum can be removed. This permits inspection of the component parts on the underside of the tuner. Worn spring contacts can be replaced and the entire drum section can be inspected for worn points on the plug-in coil sections. Coil sections with badly worn contacts should be replaced.

The moving parts of the drum mechanism should also be inspected and lubricated with pure mineral oil. If the spring-detent mechanism which locks the drum in place on each channel is defective, it should also be replaced.

Antenna overhaul

After the various troublesome circuits of the receiver have been overhauled, the antenna system should be inspected. In most instances an old receiver also means an over-age antenna system. Regardless of the type of material used, continued exposure will corrode the insulators and the antenna elements.

As a rule, antennas which have been in use for two years or more will give inferior results through rust, corrosion, and poor contact. If the customer is willing, a complete new antenna and transmission line will help restore the installation to peak condition. If the set is in an area which will be served by u.h.f. it may be advisable to install one of the new combination v.h.f.-u.h.f. antennas. In other instances a separate u.h.f. antenna and lead-in can be installed depending on the type of u.h.f. adapter. Some adapters and TV receivers with built-in u.h.f. units have provisions for both v.h.f. and u.h.f. antennas. A switch throws in the proper antenna as required.

Sometimes the set owner uses only a built-in antenna in areas where an outdoor antenna would improve performance to a considerable degree. The technician should recommend a good outdoor installation to do justice to the overhauled job.

General overhaul

We have covered some of the essential circuits which usually require overhaul after the receiver has aged. Other circuits may, of course, also require extensive changes. If the customer is willing to spend the additional money, the technician can do a great deal to bring the receiver up to peak performance and assure continued peak operation. This would mean replacing all tubes which are even slightly below par. Many experienced technicians recommend replacing *all* coupling capacitors during a general overhaul. This minimizes the danger of a coupling capacitor becoming leaky after the set has been overhauled. Leaky coupling capacitors can cause extensive damage by impressing B plus on the grid of the following stage. The tube may be ruined and other parts may overheat because of the excessive drain on the power supply.

During the overhaul process it is also worthwhile to check the service notes and supplements on the receiver for any production changes made by the manufacturer. Such information is furnished by the "Servicer" supplement to Sams' *Photofact* Schematics or the card supplements to the Rider *Tek-Files*. If you are using the manufacturer's original service manuals, refer to the supplements issued for each receiver. These supplements often recommend important changes or modifications to the receiver to improve general performance. Very few receivers have not had some production changes made after the initial models were released. Field findings usually disclose several changes which would improve the receiver's stability, performance, and noise immunity. Here are a few specific examples:

Early runs of Admiral model 26R25 receivers had a high 60-cycle hum. In a supplement the manufacturer recommended that the ground lead from the volume control be connected to the grounded *cathode pin* of the first audio tube (6AU6), instead of to the grounded heater pin. This removes the ground lead of the volume control from a point which might introduce an audible hum. Besides this, the manufacturer recommends that the a.c.-power leads to the on-off switch on the volume control be dressed away from the grid circuit. In addition, the .01-μf coupling capacitor between the volume control and grid may be reversed. For minimum hum pickup, the outside foil should be connected to the volume control. (This also applies to other receivers and should be considered in every general overhaul.)

Another instance is the recommendation given in the supplements on General Electric 14T2, 14T3, and others. In early models the 25BQ6 horizontal output tube had no cathode resistor. Bias for the tube was developed by grid rectification of the drive voltage. Failure of the horizontal sweep oscillator and loss of drive would cause excessive plate current in the output tube. General Electric recommends inserting a 39-ohm, 1-watt resistor between the 25BQ6 cathode (pin 8) and the B minus bus, and returning the 10,500-ohm screen-bleeder resistor and 0.1-μf bypass capacitor to the cathode instead of to B minus. Other leads should be dressed away from these resistors so that the heat will not affect adjacent parts. The cathode resistor will develop sufficient bias voltage to protect the tube if the drive from the horizontal oscillator fails.

Virtually all the changes recommended in the supplements have been incorporated in subsequent receivers. In some instances more extensive changes are recommended. One such case is the Emerson model 676B series using chassis 120140B. Here, sync stability in fringe areas can be improved by making several changes in the sync-separator circuit shown in Fig. 5. The 100,000-ohm resistor should be replaced by a 470,000-ohm, ½ watt resistor. The 100,000-ohm resistor is then connected between the .047-μf capacitor and the 10,000-ohm resistor from the sync amplifier. This change in position is shown by the dashed line in Fig. 5.

Stability can be improved still more in fringe areas where ignition noise is not too severe, by adding a .047-μf capacitor across the 110-μμf unit and 2.2-megohm resistor at the grid of the sync-separator tube.

These examples illustrate the importance of checking supplementary service notes. The changes recommended by the manufacturer will increase the serviceability of the receiver and improve it beyond the mere overhaul which would restore it only to its original condition.

A good time to recommend a complete overhaul is during seasonal periods when routine service business is slow. You have the time, then, and first-class overhauls of customers' receivers and antenna systems are fine for building your reputation and augmenting your income.

END

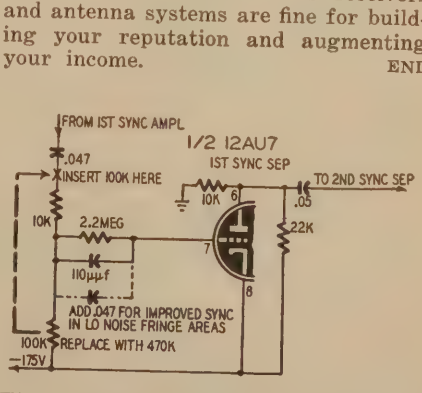
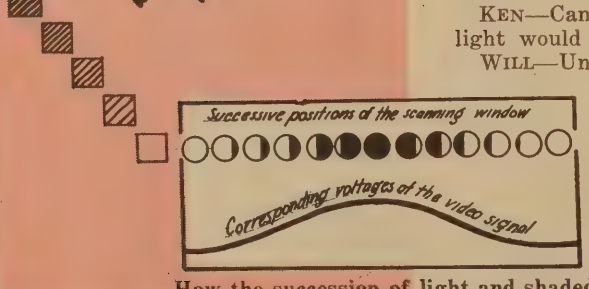


Fig. 5—Circuit changes recommended by Emerson for improved sync in 676B.

TELEVISION? ...it's a cinch!

By E. AISBERG

● **First conversation, second half.** Ken and Will discuss square and sine waves; maximum video frequency; interference problems; carrier frequencies and their relation to the frequencies of the information signals they carry.



How the succession of light and shaded pulses produces a sine-wave alternation.

Square wave or sine?

WILL—Funny looking, these video signals. Not much like the smooth-looking sine waves we have in radio. These are more like the top of an old castle.

KEN—Not as different as you might think! And for two reasons: first, these square waves can be broken down into a large number of sine waves. You can start out with a fundamental sine wave of the same frequency as your square wave, and add other frequencies 3, 5, 7, and more *odd* times as great and come out with a pretty respectable square wave. Frequencies which are multiples of a fundamental are called *harmonics*. They make it hard for our video signal to get through any amplifier. If the fundamental frequency is high, the harmonics must be even higher. And even an amplifier designed for a wide band of frequencies has to have a limit somewhere.

WILL—And the other reason?

KEN—Let's just make a little experiment. Take this piece of paper and punch a little round hole in it. Think of the hole as being exactly the size of one image element. Now rule a piece of paper with bars and spaces the same width as the hole, and move your little window in the paper across the black and white bars that make up our image.

WILL—We're analyzing the elements just like television!

KEN—Exactly. Notice that as you sweep your window across the image, sometimes the window is exactly over a black bar or exactly over a white one. But we don't jump from one of those ideal positions right over to the other. We have to pass across all the intermediate positions where part of the area is white and the other part black. Suppose we get far enough away from the piece of paper so our eyes can't separate the black and white parts of the view under our little window. Now, as I move the paper, what do you see?

WILL—Well, there's a gray surface there, and when you move the paper it gets darker till it's black, then starts lightening up again to a dark gray which keeps on getting lighter till it's white. Then it starts darkening till it gets all black again. I seem to be seeing the *average* shade of the area under the window.

KEN—Can you guess what kind of a voltage pattern these variations in light would produce?

WILL—Unless I've forgotten all my radio training, it'll be our old friend the sine wave.

A little arithmetic

KEN—Now I think we can figure out the maximum frequency of our sine waves. First of all, let's find out how many elements our picture is divided into. We'll call the height H and the width L. Now when we scan the picture we cover it with N horizontal lines (of length L) and there are *n* image a second.

WILL—This begins to look like an algebra problem.

KEN—It'll be a simple one. Now just think of each element as a little square. Now let's draw a line down the picture anywhere and produce a number of squares. Now, how high is each square?

WILL—Well, it should be the total height of the picture divided by the number of horizontal lines.

KEN—Exactly! Or we call the height of each square H/N. And since it is a square, it's just as wide as it's high, so the width of a square is H/N too. You can say that the total number of elements in a horizontal line is the length of the line divided by the width of a square, or:

$$\frac{L}{H/N} = \frac{LN}{H} \text{ elements in a single horizontal line.}$$

Now, the whole picture contains N lines, so the complete image contains the number of elements on one line multiplied by the number of lines in the picture or

$$\frac{LN}{H} \times N = \frac{LN^2}{H} \text{ elements.}$$

WILL—Yeah, that looks logical.

KEN—Now, since all the elements in an image have to be transmitted n times a second, we have $\frac{LN^2n}{H}$ elements a second. But since it takes two elements to make up a cycle, we can divide our formula by two, and have

$$\frac{LN^2n}{2H} \text{ cycles a second.}$$

This is far from being an exact formula; it doesn't bother with the time taken to get back from the end of each line to the beginning of the next, and from the bottom back to the top—we'll talk about that another time. But it *is* good enough to give us the *maximum video frequency.*

WILL—Each one of these little equations looks reasonable while we're looking at it. But now that they're all down, the whole thing doesn't seem much. Can you put in some real figures instead of N and n—something that would show me the number of elements on my own TV screen for instance? Then I'd probably get it.

KEN—O.K. Suppose you do the figuring. The television screen is shaped so that, no matter what size it is, it is four units wide to three units high. Of course, you can put in the width and height of your own TV screen—if you know it—but it is easier to just let 4 stand for the width and 3 for the height. And it will be right for any screen. We scan it with N = 525 lines at the rate of n=30 images per second. Take it away, Einstein!

WILL—Let's see, we have:

$$\frac{4 \times 525^2 \times 30}{2 \times 3} = 5{,}512{,}500 \text{ cycles per second.}$$

Wow! More than five and a half *megacycles!*

Return of the elephant

KEN—Now do you want to go ahead with your proposition to "make a little space" for television in the broadcast band?

WILL—H'm, the broadcast band runs from 540,000 to 1,600,000 cycles, or 540 to 1,600 kc. It's a little more than a million cycles wide. But, with two sidebands, our television transmission is going to be more than ten million cycles wide! No, our elephant will never get into this particular snailshell!

KEN—It's not quite as bad as it seems. You'll learn later on that we can get rid of most of one sideband. And for practical purposes, the other one is limited to 4,500,000 cycles. So a TV channel is 6,000,000 cycles—or 6 megacycles wide. But that's plenty wide. If we put one edge of a channel in the middle of the broadcast band, say at 1,000 kc or 1 mc, where would the other edge be?

WILL—At 7 megacycles, or around the 40-meter band. We'd use the whole spectrum from 40 to 300 meters just for one TV station! But with widths like that, how do they squeeze it in anywhere?

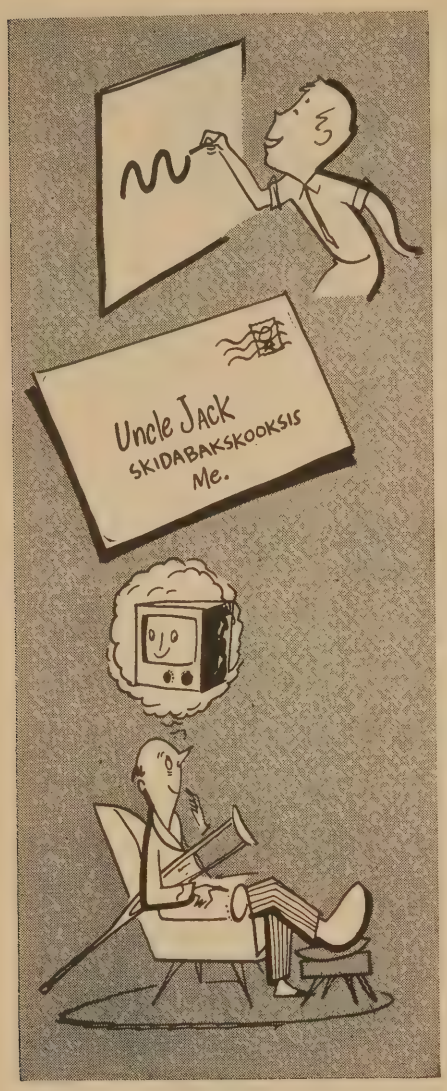
KEN—It's a lot easier on the higher frequencies. Take the two lower television bands. Channel 2 runs from 54 to 60 mc, or just a little more than five meters. Channel 11 runs from 198 to 204 megacycles, which is just over one meter.

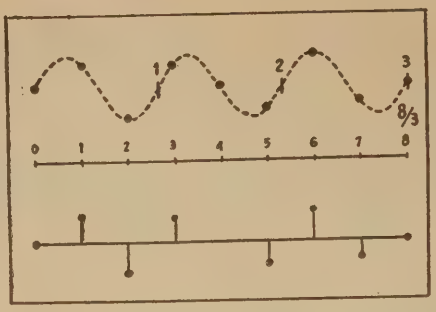
WILL—Yeah! I can see now why TV has to be on the higher frequencies.

KEN—There's another reason. If we want good modulation, the carrier frequency has to be several times as high as the modulation frequency.

WILL—How come?

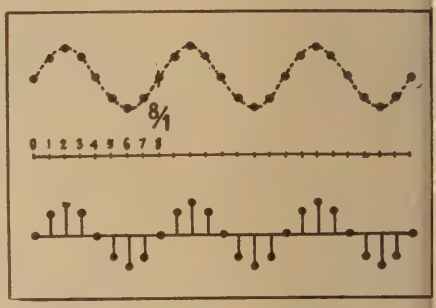
KEN—Well, we spoke earlier of the carrier wave sort of carrying the audio signal on its back. But there's a little more to it than that. Each wave carries a little piece of audio signal—takes a little sample as it were. And if your frequency isn't high enough to take a large number of samples, they may not represent the real shape and size of the audio waves. Suppose, for example, that there are eight cycles of the carrier to each 3 of the signal—that is, a





Above is shown the result of trying to transmit a sine-wave signal on a carrier frequency which has eight cycles to the signal's three. The reproduced values shown in the bottom line are far too few to help in reconstructing the original signal, which would more likely be taken for a sawtooth.

But if the carrier wave is a eight times the signal frequency, it transmits a large enough number of instantaneous values to make it possible to build up a faithful reproduction of the original signal. This is shown in the figure below.



ratio of 8–3 between them. The instantaneous values of audio signal we would transmit would be altogether too widely spaced, and you would never recognize the output as the signal you tried to modulate the carrier with. But if you choose a carrier whose frequency is, say, eight times that of the signal, you would transmit enough instantaneous values to make a fair copy of the signal.

WILL—Something like those newspaper pictures again. If the dots get too far apart, you can't make out the fine detail in the picture.

KEN—Not a bad comparison at all!

Too bad for uncle

WILL—Now let's see what I've learned: Television signals occupy a very wide band of frequencies. They can't be carried except by very-high-frequency waves. Those waves travel in straight lines, without doing much bending around the earth, so their range is strictly limited. And the result of all this is . . . my Uncle Jack just isn't going to get television!

KEN—I'm sorry for Uncle Jack. But you've learned something of the principles of television transmission. . . .

WILL—. . . which at first seemed to be complicated, but are turning out to be very simple. Television is a cinch!

(TO BE CONTINUED)

AVERAGE TV SERVICE DEALER DISCOVERED

The average TV service dealer employs 5.3 service technicians, as against only 1.4 technicians for the average radio service dealer. The facts were disclosed by John T. Thompson, manager of replacement-tube sales for the Tube Department of General Electric Co., which has completed a survey on the subject.

The average TV service dealer, the survey discovered, was making $21,000 annually, and his 5.3 service technicians each made 37 calls a week, at an average of $8 per call, in 1951.

In 1952 his gross service income was up 27% over 1951, but his *rate of increase* declined. In 1951, his service gross was 35% more than the previous year.

His shop covers 1,000 square feet of floor space, including an average of 92 square feet of service space for each technician. His business is on such a scale that he employs an accountant to handle his bookkeeping and accounting, and his various tax problems.

In taking the survey, which includes replies from 2,175 full-time service dealers, those dealers whose service business included more than 75% TV service were classified as TV service dealers. Similar data was also obtained for radio service dealers, those dealers whose business consists of more than 75% radio service, and a "general" service dealer, whose service business includes about equal proportions of both radio and TV service.

More than half of the dealers whose returns were tabulated reported that they had more business than they could handle. Two-thirds reported that they had been in business for more than six years.

A comparison of returns from television, radio, and general service dealers indicates that the larger the proportion of television service business, the more extensive are the operations of the service dealer. While the television service dealer was earning $21,000 last year, the radio service dealer was making $9,000 and the general service dealer $15,500.

By averaging the returns in each of the three classifications, the G-E Tube Department came up with these results:

TYPICAL DEALER		RADIO	GEN'L SERV.	TV
Average number of service technicians employed		1.4	2.7	5
Percentage of service calls handled in the home		10%	60%	80
Square feet of floor space		700	900	1,0
Square feet of service space per technician		250	174	
Who handles bookkeeping and accounting		Owner	Owner	Acct
Jobs per week—each technician		32	35	
Average billing per service call		*$5.50*	*$7.50*	*$8.*
Volume of service business	1950	$7,500	$12,005	*$15,5
	1951	9,000	15,500	* 21,0
Increase in business	1950 *vs* 1951	+20%	+24%	+3
	1951 *vs* 1952	+13%	+23%	+2

*Including some additional parts business not covered by average service call billings.

30 TV STATIONS TO CHANGE FREQUENCIES

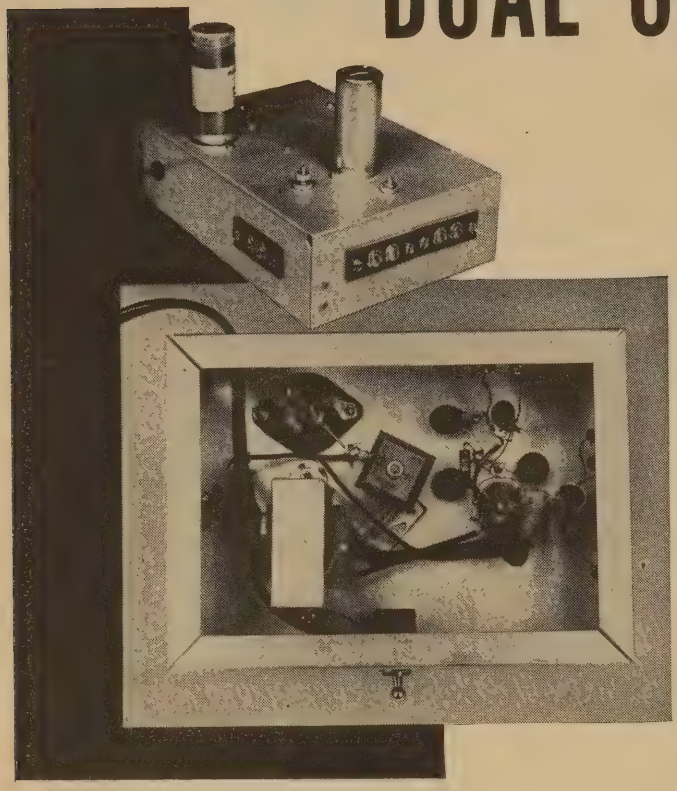
AS PART OF the allocations plan of the FCC, 30 of the stations in operation at the time of the unfreeze were scheduled to adopt new frequencies. This was done in the interest of greater over-all efficiency and better use of the available channels.

The 30 stations, with the dates of change where available, are listed below. The columns headed "FROM" and "TO" refer of course to channel numbers, and the abbreviation "ERP" is "effective radiated power."

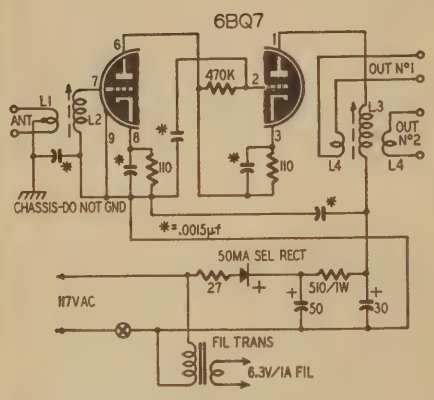
It may be noted that where date of change and change in power are both noted, the two may not be simultaneous. Both date of change and date of power increase depend on the co-operation of other stations which are to change at or near the same time. Due to interference which may result if one station changes frequency while others in the same geographical area have not changed, some temporary modifications in power, direction, or other operating conditions may be necessary till all stations have made scheduled changes. For this reason also, some stations on the list are not sure of the exact date when the authorized changeover will take place, and that information is not given.

STATION	CITY AND STATE	FROM CH.	ERP (kw)	TO CH.	ERP (kw)	DATE OF CHANGE	REMARKS
WAVE-TV	Louisville 2, Ky.	5	24.1	3	100	Feb. 1	Changing location of transmitter. Will increase height above average terrain from 510 to 914 feet.
WBKB	Chicago, Ill.	4		2		Indefinite	Have placed tentative orders for equipment. Waiting for FCC notification.
WBRC-TV	Birmingham, Ala.	4		6			
WCPO-TV	Cincinnati, Ohio	7	24	9	48	December 1952	New amplifier (winter 1953). ERP will be 316 kw.
WDEL-TV	Wilmington, Del.	7		12		Some time in 1953	
WDTV	Pittsburgh, Pa.	3		2	16	Nov. 23, 1952	Plan to change to 100 kw in spring.
WGAL-TV	Lancaster, Pa.	4		8			
WHAM-TV	Rochester, N. Y.	6	23.4	5	100	June or July	Must wait for WSYR-TV in Syracuse to vacate channel 5.
WHAS-TV	Louisville, Ky.	9		11			
WHIO-TV	Dayton, Ohio	13		7	316	Frequency change in early spring	Will increase antenna height to 1,145 feet above average terrain. New transmitting station and tower will be completed late in 1953.
WJAC-TV	Johnstown, Pa.	13		6	70	October 4, 1952	Antenna height 1,120 feet above average terrain.
WJAR-TV	Providence, R. I.	11	30	10	200	Early in 1953	Have ordered 50-kw TV transmitter which is expected in late spring of 1954. Will have 316 kw ERP by end of 1954 or early 1956.
WKRC-TV	Cincinnati, Ohio	11	24.5	12	same	October 26, 1952	Expect to increase ERP to 200 kw early in 1953.
WLTV	Atlanta, Ga.	8		11	316	Fall	
WLW-C	Columbus, Ohio	3		4		No definite date	
WLW-D	Dayton, Ohio	5		2	100	No definite date	Awaiting FCC hearing because of overlap in coverage areas.
WLW-T	Cincinnati, Ohio	4		5		Spring	
WMCT	Memphis, Tenn.	4		5	60	December 1952	
WNHC-TV	New Haven, Conn.	6		8		Late spring	
WNBK	Cleveland, Ohio	9	39.22	8			Will change transmitter site.
WOC-TV	Davenport, Iowa	5		6		No definite date	
WOI-TV	Ames, Iowa	4		5		Summer	Expect to double present power.
WOOD-TV	Grand Rapids, Mich.	7		8		April 15	
WRGB	Schenectady, N. Y.	4		6		No definite date	Must wait for WNHC-TV at New Haven to vacate channel 6.
WSAZ-TV	Huntington, W. Va.	5		3		August 5, 1952	Using directional antenna with null toward WLW-C Columbus. Will return to nondirectional pattern when WLW-C moves off channel 3.
WSYR-TV	Syracuse, N. Y.	5		3	100	Late spring or early summer	
WTAR-TV	Norfolk, Va.	4		3	100	June or July	
WTMJ	Milwaukee, Wis.	3		4	100	Early spring	1,017-foot tower now under construction.
WTTV	Bloomington, Ind.	10		4	100		
WXEL	Cleveland, Ohio	9		8	316	Late summer	Installing a 750-foot tower and 50-kw transmitter.

DUAL OUTPUT BOOSTER



By EDWIN BOHR



Above-and below-chassis photos and schematic of the dual-output cascode booster. It can be operated remotely.

THIS dual-output booster provides satisfactory and inexpensive operation of two fringe-area TV sets from a single antenna. Here is the story that inspired it.

In this area—approximately 100 miles from Atlanta, Georgia—only one Atlanta station lays down a really strong signal. This station is on channel 2. A tenant in a local dwelling installed a channel 2 Yagi and mast on his roof. With a booster, the picture was quite clear and relatively free from snow. The landlord's mouth began to water when he saw the beautiful picture the tenant was getting. In no time at all, the landlord, who lived only about 35 feet from the tenant, got himself a TV receiver and a booster and hooked onto the tenant's antenna (this was agreed upon). They simply paralleled the booster inputs to the antenna.

Things did not work out so well. Tuning one booster would drastically affect the signal strength at the other; there were very large standing waves on the line; and sometimes one of the boosters would oscillate, ruining reception on both receivers. The tenant, by arrangement with a large electronics parts distributor, was able to try many other boosters and gadgets—but nothing helped very much.

At this point, when it seemed that the only solution was another antenna, a new idea presented itself: Why not build a booster with two output windings on the plate coil—one winding to feed each set? The number of turns on each winding could be adjusted so there would not be too much swamping of the tuned circuit.

The simple cascode circuit shown in Fig. 1, with a selenium-rectifier power supply, was built on a small chassis. Two output links were wound over the plate coil and each was connected to a TV set. The booster's performance exceeded everyone's expectations. There was absolutely no interaction between the two sets and the noise level and gain were as good as, if not better than, the other boosters used.

Construction

Layout and wiring are shown in the photographs. The power supply is not isolated from the power line. This is satisfactory since the booster is isolated from the antenna and the TV sets by the input and output transformers. The antenna-coil center-tap is grounded to the chassis and the chassis is isolated from the B minus lead by a .0015-μf capacitor. This arrangement is shock-proof. However, a small isolation transformer may be used if desired. At first glance, the plate-supply voltage may seem a little low, but tests showed that there was no noticeable deterioration of picture quality with B plus of only 145 volts.

All bypass capacitors were mounted as close to the tube socket as possible. The grid and plate windings were given heavy coats of coil dope before the antenna and receiver windings were added. This gives the necessary electrical insulation between antenna, booster, and receivers. Other TV channels could be covered with this unit by changing the coil sizes. It is also possible to have one output 300 ohms and the other 72 ohms, or make both outputs 72 ohms (see coil data).

(Although this booster was designed for use on channel 2, it can be made to work equally well on the remaining v.h.f. and FM channels by making slight changes in the winding and tuning of L2 and L3. If the booster tunes to channel 2 with a powdered-iron slug turned well into the coil, channels 3 and 4 can probably be tuned by screwing out the slug. The inductance of these coils can be reduced further by spreading the turns and by removing a

Coil data for channel 2

L1	L2	L3	L4 300 ohm	L4 75 ohm
3 turns	10 turns	11 turns	2 turns	1 turn

Materials for booster

All coils No. 26 enamelled wire, close-wound on ⅜-inch diameter slugtuned coil forms (Cambridge Thermionic type LS-3 or equivalent). L1 is center-tapped. The L4 windings are wound close together, directly over L3.
Resistors: 1—510 ohms, 1 watt; 1—470,000 ohms, 2—110 ohms, 1—27 ohms ½ watt.
Capacitors: (Electrolytic) 1—50 μf, 1—30 μf, 150 volts; (Disc type ceramic) 5—.0015 μf, 500 volts.
Miscellaneous: 1 filament transformer, primary 117 volts, secondary 6.3 volts, 1 amp; 1—50-ma selenium rectifier; 1 6BQ7 tube; 1—9-pin miniature socket; 2—⅜-inch diameter slug-tuned coil forms (Cambridge Thermionic type LS-3 or equivalent); 1—s.p.s.t. toggle switch; chassis; terminals; line cord; hardware; wire solder.

turn or two at a time until you reach the desired channel. For the high-band channels, start with about 5 turns each for L2 and L3. A grid-dip meter will be useful in checking the resonant frequency of a particular coil with different positions of the tuning slug.—*Editor*)

Everyone who has built this booster is surprised at how well it performs. The really gratifying feature was the price. The entire bill for parts was $8.12. The combined cost of the other two boosters was more than $30. If another antenna had been used, two boosters still would have to be bought, plus another mast and antenna. In short, this little dual-output booster provided both sets with excellent reception at a price far below the cost of even the cheapest booster.

To operate two sets in this area, some service technicians either have erected two separate masts and antennas or have mounted two antennas on a single mast. In other words, the cost of everything—antennas and boosters—is just about doubled. This dual unit, together with an inexpensive time clock (to turn the booster on and off), can be mounted out of sight in an attic or basement to operate two sets without the TV set owners having to own and operate separate boosters. The service technician therefore can make a very good profit and win a great deal of good will by using this efficient, simplified arrangement. END

GLOSSARY

of working definitions for color TV, as approved by the National Technical Standards Committee

(Slightly abridged by omission of notes)

BLACK-AND-WHITE. Deprecated. *See* MONOCHROME.

BRIGHTNESS. The attribute of visual perception in accordance with which an area appears to emit more or less light.

BURST PEDESTAL. *See* COLOR-BURST PEDESTAL.

BYPASS MIXED HIGHS. The mixed-highs signal that is shunted around the color-subcarrier modulator or demodulator.

BYPASS MONOCHROME SIGNAL. A monochrome signal that is shunted around the color-subcarrier modulator or demodulator.

CAMERA SPECTRAL CHARACTERISTIC. The sensitivity of each of the camera color-separation channels with respect to light wavelength.

NOTE 1: It is necessary to state the camera terminals at which the characteristics apply.

NOTE 2: Because of nonlinearity, the spectral characteristics of some cameras depend upon the magnitude of radiance used in their measurement.

NOTE 3: Nonlinearizing and matrixing operations may be performed within the camera.

CARRIER COLOR SIGNAL. The sidebands of the modulated color subcarrier (plus the color subcarrier, if not suppressed) which are added to the monochrome signal to convey color information.

CHROMINANCE. The colorimetric difference between any color and a reference color of equal luminance, the reference color having a specified chromaticity.

CHROMINANCE CHANNEL. In a color television system any path which is intended to carry the carrier color signal.

COLOR BURST. A few sine-wave cycles of color subcarrier frequency (and the color-burst pedestal, if present) which is added to the "back porch" of the horizontal pedestal for synchronizing the color-carrier reference oscillator.

COLOR-BURST PEDESTAL. The rectangular pulse-like component which may be part of the color burst. The amplitude of the color burst pedestal is measured from the a.c. axis of the sine-wave portion to the horizontal pedestal.

COLOR-CARRIER REFERENCE. A continuous signal having the same frequency as the color subcarrier and having fixed phase with respect to the color burst. This signal is used for modulation at the transmitter and demodulation at the receiver.

COLOR CO-ORDINATE TRANSFORMATION. Computation of the tristimulus values of colors in terms of one set of primaries from the tristimulus values of the same colors in another set of primaries.

NOTE: This computation may be performed electrically in a color television system.

COLOR DIFFERENCE SIGNAL. An electrical signal which when added to the monochrome signal produces a signal representing one of the tristimulus values (with respect to a stated set of primaries) of the transmitted color.

COLOR EDGING. Spurious color at the boundaries of differently colored areas in the picture.

COLOR PHASE (of a given subcarrier component). The phase, with respect to the color-carrier reference, of the component of the carrier color signal which transmits a particular color signal.

COLOR PHASE ALTERNATION (CPA). The periodic changing of the color phase of one or more components of the color subcarrier between two sets of assigned values.

COLOR PICTURE SIGNAL. The electrical signal which represents color picture information, consisting of a monochrome component plus a subcarrier modulated with color information, excluding synchronizing signals.

COLOR SUBCARRIER. The carrier whose modulation sidebands are added to the monochrome signal to convey color information.

COLOR SYNC SIGNAL. *See* COLOR BURST.

COLOR TRANSMISSION. In television, the transmission of a signal for controlling both the luminance values and the chromaticity values in a picture.

COMPATIBILITY. The nature of a color television system which permits substantially normal monochrome reception of the transmission by typical unaltered monochrome receivers.

COMPOSITE COLOR SIGNAL. The color picture, including blanking and all synchronizing signals.

CONSTANT-LUMINANCE TRANSMISSION. A method of color transmission in which the carrier color signal controls the chromaticity of the produced image without affecting the luminance, the luminance being controlled by the monochrome signal.

DELAY DISTORTION. That form of distortion which occurs when the envelope delay of a circuit or system is not constant over the frequency range required for transmission.

ENVELOPE DELAY. The first derivative of the phase shift with reference to the frequency.

NOTE: If the phase is measured in radians and the frequency in radians per second, the envelope delay will be in seconds.

FIELD. One of the two (or more) equal parts into which a frame is divided in interlaced scanning.

FREQUENCY OVERLAP. In a color television system that part of the frequency band which is common to the monochrome channel and the chrominance channel.

GAMMA. In a color or monochrome channel, or part thereof, the coefficient expressing the selected evaluation of the slope of the used part of the log vs. log plot relating input (abscissa) and output (ordinate) signal magnitudes as measured from the point corresponding to some reference black level.

GAMMA CORRECTION. The modification of a transfer characteristic for the purpose of changing the value of gamma.

LUMINANCE. Luminous flux emitted, reflected, or transmitted per unit solid angle per unit projected area of the source.

LUMINANCE CHANNEL. In a color television system any path which is intended to carry the luminance signal.

NOTE: The luminance channel may also carry other signals, for example, the carrier color signal, which may or may not be used.

LUMINANCE SIGNAL. A signal wave which is intended to have exclusive control of the luminance of the picture.

LUMINOSITY. Ratio of photometric quantity to corresponding radiometric quantity in standard units (lumens per watt).

LUMINOUS FLUX. The time rate of flow of light. When radiant flux is evaluated with respect to its capacity to evoke the brightness attribute of visual sensation, it is called luminous flux, and this capacity is expressed in lumens.

MATRIX.

(a) (*Noun*). In color television an array of coefficients symbolic of an operation to be performed, which operation results in a color coordinate transformation. (This definition is consistent with mathematical usage.)

(b) (*Verb*). In color television, to perform a color coordinate transformation by computation or by electrical, optical, or other means.

MATRIXER (MATRIX UNIT, MATRIX CIRCUIT, ETC.). A device which performs a color coordinate transformation by electrical, optical, or other means.

MIXED HIGHS. Those high-frequency components of the picture signal which are intended to be reproduced achromatically in a color picture.

MODULATED COLOR SUBCARRIER. *See* CARRIER COLOR SIGNAL.

MOIRE. In television the spurious pattern in the reproduced picture resulting from interference beats between two sets of periodic structures in the image.

MONOCHROME. Black-and-white. ("Monochrome" is the preferred term.)

MONOCHROME BANDWIDTH (of the signal). The video bandwidth of the monochrome signal.

MONOCHROME BANDWIDTH (of the monochrome channel). The video bandwidth of the monochrome channel.

MONOCHROME CHANNEL. In a color television transmission any path which is intended to carry the monochrome signal.

MONOCHROME SIGNAL. (a) In monochrome television transmission a signal wave for controlling the luminance values in the picture but not the chromaticity values.

(b) In color television transmission that part of the signal which has major control of the luminance of the color picture and which controls the luminance of the picture on a conventional monochrome receiver.

MONOCHROME TRANSMISSION. In television the transmission of a signal for controlling the luminance values in the picture, but not the chromaticity values.

PICKUP SPECTRAL CHARACTERISTIC. The set of spectral responses of the device, including the optical parts, which converts radiation into electric signals, prior to any nonlinearizing and matrixing operations.

RECEIVER PRIMARIES. The colors of constant chromaticity and variable luminance produced by the receiver, which, when mixed in proper proportions, are used to produce other colors.

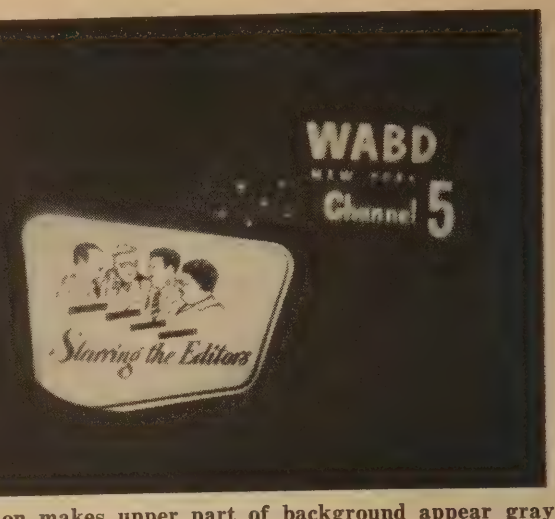
NOTE: Usually three primaries are used: red, green, and blue.

STATIONERY CPA AXIS. A fixed reference phase with respect to which a carrier color signal of constant chrominance makes equal and opposite angles for successive fields, this reference phase being the same for all chrominances.

ZERO-SUBCARRIER CHROMATICITY. The chromaticity which is intended to be displayed when the subcarrier amplitude is zero. END

TV SERVICE CLINIC

Conducted by MATTHEW MANDL*



Poor d.c. restoration makes upper part of background appear gray.

MANY readers still inquire about conversions to larger picture tubes. Their questions generally relate to change-overs from 14- or 16-inch tubes to the 21-inch size. If the receiver cabinet can accommodate the larger tube the electronic changes required are generally easier than conversions from 10-inch tubes to the 14- or 16-inch types. This is especially true if the 14- or 16-inch tube to be replaced is operating at its full rated second-anode voltage.

If the present tube has a deflection angle of 66 degrees or more and is used with a wide-angle horizontal-output transformer and matching yoke, a larger tube can usually be substituted without any major electrical changes. For maximum brilliancy and sweep width, check the horizontal-output tube, the damper, and the high-voltage rectifier. Also make sure the ion-trap magnet is the correct type (double- or single-magnet); has the right field strength; and is located on the tube neck for maximum brilliancy. Refer to previous conversion articles in RADIO-ELECTRONICS for additional hints on getting optimum performance. In particular, re-read the article "TV Conversion Details" in the March, 1952, issue.

Rectangular tubes have a diagonal-deflection angle of 70 degrees. The following *round-face* 16-inch tubes have deflection angles of more than 65 degrees, and sets which have been designed for them are easy to convert to 20- and 21-inch rectangulars:

16GP4, -A, -B	16VP4
	16WP4
16SP4	16YP4

Twelve- and 15-inch tubes, and the following 16-inch types have deflection angles less than 66 degrees:

16AP4, -A, -B	16FP4
	16HP4
16CP4	16JP4
16DP4	16LP4
16EP4	16MP4
	16ZP4

New wide-angle horizontal output transformers, matching yokes, and focus units are necessary for converting sets with these tubes to 20- or 21-inch rectangular types.

Kits of matched parts and individual components for these large-tube conversions are made by Du Mont, Merit, Ram, RCA, Stancor, and others. A single driver tube (6BG6-G) and a single high-voltage rectifier (1B3-GT) are sufficient with the conventional flyback circuit shown in Fig. 1. Typical components for this circuit would be a Merit HVO-7 flyback transformer, a matching MFD-70 yoke, and an MWC-1 width coil.

A RAM XO53 flyback transformer and Y70F10 yoke can also be used. For 20- or 21-inch tubes use a 201R3 linearity coil and 201R1 width coil. For 24-inch tubes the 201R4 linearity coil and 201R5 width coil are recommended.

Direct-drive systems can be used if an extra filament winding can be provided for the 6W4-GT damper. A typical combination is the RCA 211D1 wide-focus yoke and 225T1 flyback transformer. These provide ample deflection for large-screen rectangular tubes with only minor pincushion distortion. (This type of distortion was discussed in the Television Clinic in the June, 1952, issue of RADIO-ELECTRONICS.)

Automatic-focus tubes such as the 20JP4, 21GP4, or 21KP4 can be used for conversions. The receiver focus assembly is not used with these tube types, but a ring-magnet centering unit must be used for picture positioning. Best focus is obtained automatically when the ion trap is in the correct position. The focus coil can be left in the circuit, or replaced with a fixed resistor of the same ohmic value.

In some cases 20- and 21-inch tubes are operated with second-anode voltages as high as 16,000. This provides *more than enough* brilliancy if the system is working at top efficiency, but the 14,000 volts used for 14-, 16-, and 17-inch tubes is usually adequate even with the larger types.

Buzz in Tele Tone

In a Tele Tone 322 a.c.-d.c. television receiver there is a strong intercarrier

*Author: Mandl's Television Servicing

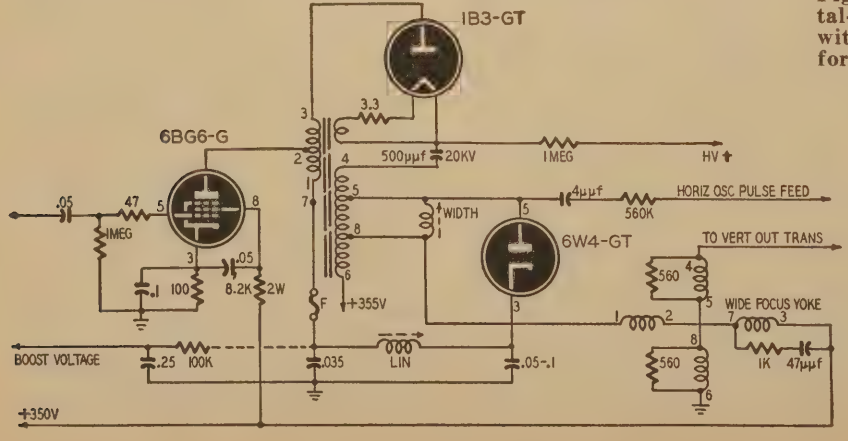


Fig. 1, left—Typical standard horizontal-deflection and high-voltage circuit, with components and values suitable for conversion to 21-inch tubes.

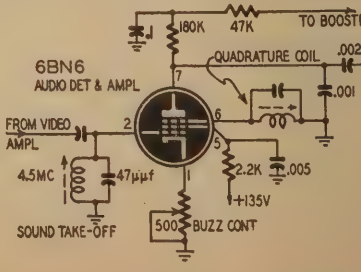


Fig. 2, below—Gated-beam sound detector circuit in Tele Tone model 322 television receiver. "Buzz-control" setting determines the minimum noise point

buzz. The fine-tuning control helps reduce the buzz but it can't be eliminated entirely. What can be done to the receiver to help? F. B., McKeesport, Pa.

This receiver has a variable resistor in the cathode of the 6BN6 sound detector-a.f. amplifier tube which acts as a buzz control, as shown in Fig. 2. It is located on the rear apron of the chassis at the right. If this doesn't eliminate the buzz, try adjusting the 4.5-mc trap in the 6BN6 grid circuit. If both these procedures fail to help, the video-i.f. stages will have to be realigned.

D.c. restoration

Is it possible for a television receiver with direct coupling between video amplifier and picture tube to show evidence of bad d.c. restoration? I understood that direct coupling meant no d.c.-restorer tube was necessary, yet I find symptoms of restoration loss in a receiver I'm working on. G. H., Merchantville, N. J.

D.c. restoration is not necessary with direct video coupling, and you should not get symptoms of poor d.c. restoration unless your video-output-amplifier tube is giving trouble. (See photo.) It is also possible that the voltage relationships between the grid and cathode of the picture tube have been upset by aging resistors or poor low-voltage power-supply regulation.

In some receivers with two-stage video amplifiers, the d.c. component is restored between the first and second video amplifiers, by driving the second-amplifier grid positive on sync tips. This establishes a d.c.-bias voltage at the second-amplifier grid which sets the black level in the picture. The RCA 630 type receiver uses this restoration method in addition to a regular d.c. restorer tube in the *picture-tube* grid circuit. Defective restoration will affect the average background of televised scenes as well as relative degrees of brilliancy on the screen. You didn't mention any specific receiver, though the one you encountered is probably the video-amplifier type. Try new video-amplifier tubes and check for defective resistors and capacitors.

Horizontal linearity

I am having linearity and width troubles with a Westinghouse H-625-T12 receiver. I have checked all resistors and capacitors by direct replacement, covering the entire horizontal strip from the a.f.c. circuit to and including the high-voltage section. I have also replaced tubes without helping the condition. What other checks should I make? Voltage and resistance measurements have tallied with the schematic. —F. S., S. Meriden, Conn.

The manufacturer has recommended a number of circuit modifications in this receiver to improve linearity, width, and general horizontal-sweep performance. (See Fig. 3.)

The capacitor in series with the 27,000-ohm resistor from pin 6 of the 12AU7 to ground should be 680 μμf as indicated *only* when the chassis has a V-9759 high-voltage transformer (manufacturer's part number). In earlier chassis—using *other* horizontal flyback transformers—this capacitor should be .001 μf for correct linearity.

Some earlier chassis that do not use the V-9759 flyback transformer have four capacitors connected in series-parallel in place of the single 100-μμf capacitor from the plate of the horizontal-output tube to ground. The series-parallel circuit was used to reduce the voltages across the individual capacitors. When the V-9759 is used, this 100-μμf capacitor or combination should be removed.

Beside making the foregoing changes, try slightly different values of resistors in the grid circuit of the horizontal output tube. This will affect drive and may help linearity.

Vertical oscillator

A Philco model 50-1486 I am servicing had no vertical deflection. I found an open vertical-blocking-oscillator transformer. I was unable to get an exact replacement but installed one I thought would be suitable. Since then I get a picture with reduced height and overlapping images. Is there anything I can do to get lock-in with a single picture? How can height be restored? C. H., Chicago, Ill.

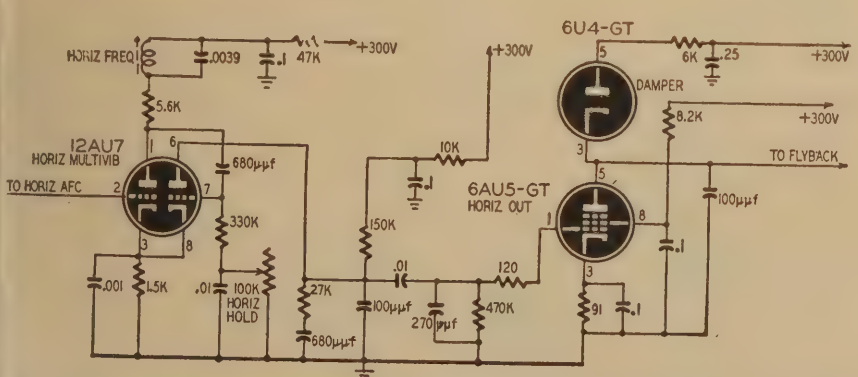


Fig. 3—Partial schematic of horizontal oscillator and output circuit from Westinghouse model H-625, T12. Values shown are for chassis with type V-9759 high-voltage transformer. Text gives details of correct parts values for other types of high-voltage transformers used on some runs of this receiver.

The new transformer undoubtedly has different characteristics from the original. This has thrown the free-running frequency of the oscillator too far off normal for proper lock-in. If the transformer is not too different from the one required, you may be able to get it near enough to the 60-cycle free-running frequency by changing capacitors and resistors in the grid circuit. This will call for some experimenting, and it would be better to get an exact replacement or one recommended by the manufacturer. The correct unit will also restore height.

Flyback replacement

In a Silvertone model 143A the horizontal-flyback transformer became leaky to a point where arcing occurred between the transformer and nearby components. I installed a replacement type which did not arc to nearby units, but developed a frying and hissing noise. The transformer doesn't overheat and the noises can be stopped by reducing the drive to the output tube. When I do this, the brightness control must be set at a maximum to get adequate brilliancy during evening viewing. Brilliancy is insufficient for daytime viewing unless the drive control is advanced. I've tried voltage checks and tube replacements without help. C. H., Minneapolis, Minn.

The troubles in both the old and new transformer are evidence that you are overdriving the horizontal-output tube. Reduce the drive to just below the point where the transformer develops noises and adjust the ion-trap magnet for maximum brilliancy.

If this adjustment doesn't give the extra margin of brilliancy desired, try a new ion-trap magnet. Also make sure the proper type is being used. Check the voltage relationships between the grid and cathode of the picture tube to make sure bias can be reduced sufficiently for maximum brilliancy. Finally check the picture tube.

Brilliancy range

In several receivers I've noticed that brightness increases up to a certain point with an advance of the brilliancy control. After that the picture starts to dim out. What would cause this? V. M., New Hyde Park, N. Y.

This usually indicates a decline in the second-anode voltage of the picture tube. Less high voltage means lower beam velocity in the tube, and the electron stream can no longer overcome the space charge set up at the phosphor coating on the tube face. When the brilliancy is advanced the greater number of electrons in the beam increases the space charge and dims the picture. Try a new horizontal-output tube and a new high-voltage rectifier. Also try a new damper tube. (If the reduction in brightness is accompanied by an increase in the size of the picture as the brightness control is advanced, the condition is known as *blooming*. Check the h.v.-filter resistor for increase in value.—*Editor*) END

CIRCUIT

Area controls and retrace blanking circuits in late television sets

By ROBERT F. SCOTT

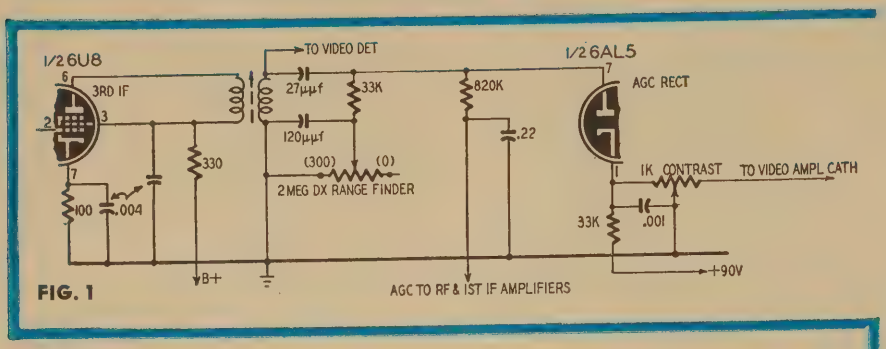


FIG. 1

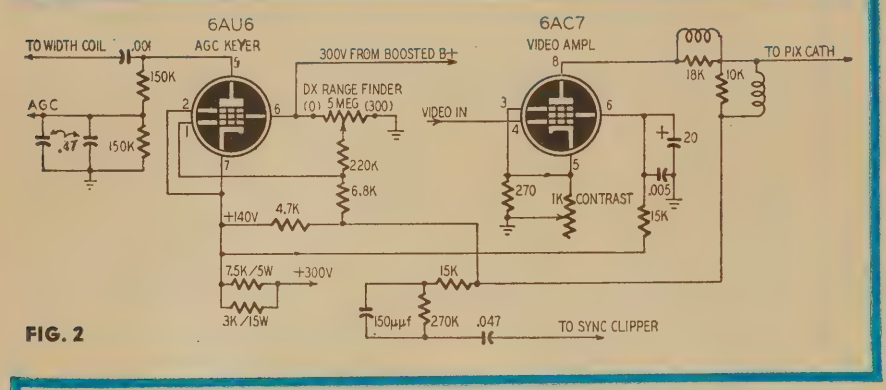


FIG. 2

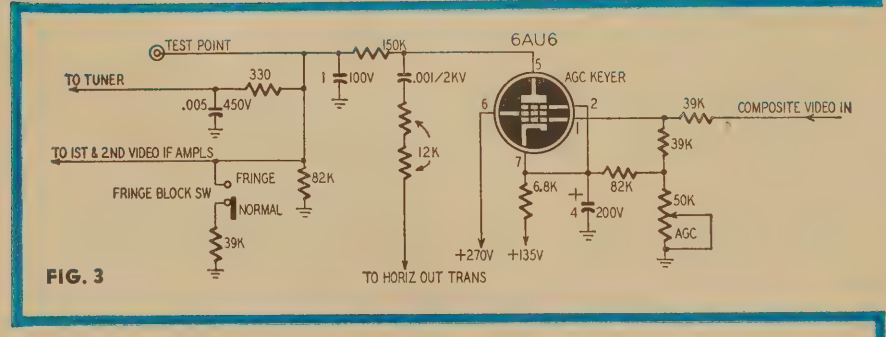


FIG. 3

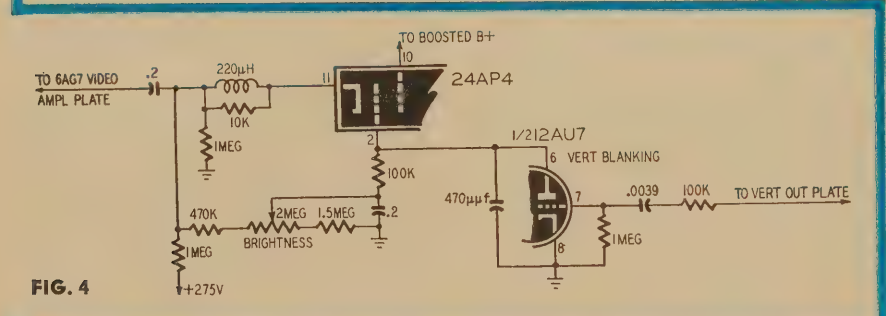


FIG. 4

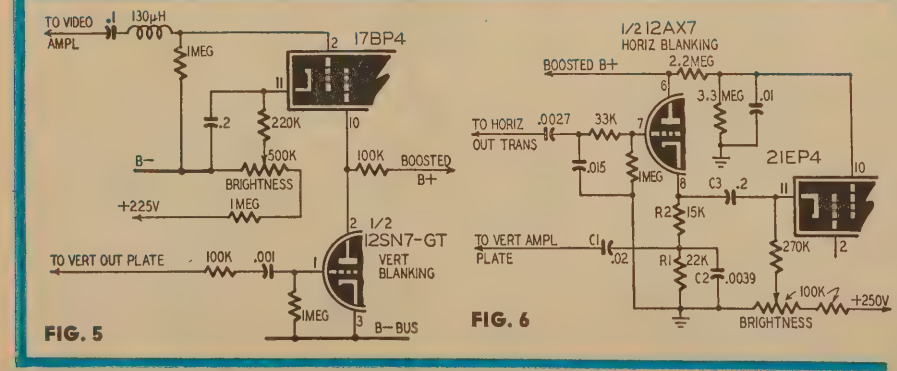


FIG. 5

FIG. 6

THE new Admiral TV receivers include a variable sensitivity control—called *DX Range Finder*—which corresponds to the local-distance area-control circuits described last month. The circuit in Fig. 1 is used in the 19B1, 19C1, and similar chassis of the 19 series. In this arrangement, the control is a 2-megohm potentiometer in series with the 33,000-ohm a.g.c.-diode load resistor. In local and strong-signal areas, the control is set to its maximum *clockwise* position (marked O), so its full resistance is in the diode load circuit. This permits the diode to develop full a.g.c. voltage to prevent overloading which may result in excessive contrast, bending of vertical objects, and poor sync.

In intermediate-signal areas, the control is usually set between 10 and 150. This reduces the diode-load resistance and the control voltage which it applies to the a.g.c. line. In fringe and weak-signal areas, the control is advanced toward 300 (minimum resistance) to further decrease the a.g.c. voltage and permit the tuner and first i.f. amplifier to operate with maximum gain.

The cathode of the a.g.c. diode is connected to a point on a voltage divider consisting of a 33,000-ohm resistor and the contrast control in series. When a strong signal is tuned in, the contrast control is adjusted to reduce the gain of the video amplifier by increasing its cathode bias. This increases the resistance in the cathode circuit of the video amplifier and *reduces* the amount of *a.g.c. delay bias* applied to the cathode of the a.g.c. rectifier.

On weaker signals, the contrast control would be advanced to reduce the bias and increase the gain of the video amplifier. This *increases* the *positive delay bias* applied to the a.g.c. diode and prevents it from conducting until the peaks of the video signal on the diode plates are more positive than the cathode.

Fig. 2 shows the *DX Range Finder* used in the Admiral 22C2 and 22E

Fig. 1—Admiral 19 series TV receivers have this *DX-Range Finder* sensitivity control for improved a.g.c. operation.

Fig. 2—*Range-Finder* circuit in Admiral 22C2 and 22E2 chassis with keyed a.g.c.

Fig. 3—Late production runs of Dumont RA-164 and RA-165 *Telesets* have *Fringe-Block* local-distance sensitivity switch.

Fig. 4—Vertical-retrace blanking circuit in G-E model 24C101 TV receiver

Fig. 5—In G-E 17T7 and 17C113, vertical-retrace blanking pulse is applied to the first anode of the picture tube

Fig. 6—Both vertical- and horizontal-retrace blanking are in G-E 21T1

SHORTS

hassis which have keyed a.g.c. The .g.c. circuit is conventional except for he fact that the grid bias of the 6AU6 keyer tube is supplied by a voltage di- ider network which includes the 5-meg- ohm *Range Finder* control as its vari- able leg. For operation in strong-signal areas, the control is usually adjusted to 0. This sets the control grid for mini- mum bias, thus permitting maximum conduction and making the a.g.c. voltage more negative. Decreasing the voltage on the grid—by turning the control toward 300—reduces the available a.g.c. voltage and permits the receiver to operate with greater gain.

Du Mont fringe block

The *fringe-block circuit* shown in Fig. 3 is used in late production runs of the Du Mont RA-164 and RA-165 chassis. These chassis use keyed a.g.c. similar to the circuit in Fig. 2. The a.g.c. potentiometer corresponds to the *Range Finder* in the Admiral chassis described above. In Fig. 3, the full a.g.c. voltage is developed across the 150,000- ohm and 82,000-ohm resistors in series. The portion of the control voltage ap- pearing across the 82,000-ohm resistor is applied to the tuner and first and second video-i.f. amplifiers through filtering and decoupling networks.

When the FRINGE BLOCK switch is in the FRINGE position, the 39,000-ohm re- sistor is connected in parallel with the 82,000-ohm unit. This reduces the effec- tive a.g.c. voltage to approximately one-third the amount developed with the switch in the NORMAL (open) posi- tion. Setting the switch on NORMAL al- lows the set to develop sufficient a.g.c. voltage to prevent overloading in strong-signal areas.

Retrace blanking circuits

Various methods of blanking out ver- tical- and horizontal-retrace lines which may degrade picture quality have been developed by TV receiver manufactu- rers. Fig. 4 shows the vertical-retrace-

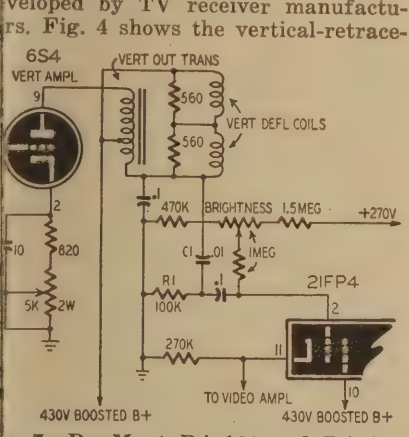


Fig. 7—Du Mont RA-164 and RA-165 *Jesets* have this vertical-retrace nking circuit. Pulse from yoke is dif- entiated and fed to C-R tube grid.

blanking circuit used in the G-E 24C101 receiver. Since the blanking voltage is applied to the grid of the picture tube, the positive-going spike which occurs during the retrace portion of the ver- tical-sweep sawtooth must be inverted. A special blanking tube is used.

The plate of the blanking tube—one- half of a 12AU7—is connected to the picture-tube grid and connected to the brightness control through a 100,000- ohm resistor. The sweep waveform at the plate of the vertical-output tube is applied to the grid of the blanking tube. The positive spike which occurs during the vertical-retrace period makes the blanking triode conduct heavily and produce a large voltage drop across the 100,000-ohm resistor.

The voltage at the triode plate and picture-tube grid drops to a level that is highly negative with respect to the picture-tube cathode. This cuts off the picture tube and blanks the screen for the duration of the retrace.

The blanking tube draws grid cur- rent on the positive spike. This charges the grid side of the .0039-μf capacitor to a high negative voltage, which cuts off the triode immediately following the positive spike. The R-C time con- stant of the grid circuit keeps the blanking tube cut off and allows the picture-tube grid voltage to rise to nor- mal.

The vertical-retrace blanking circuit of the G-E 17T7 and 17C113 is shown in Fig. 5. The video signal is applied to the picture-tube grid and the retrace- blanking signal is applied to the first anode of the picture tube. This circuit works very much in the same manner as the one in the 24C101. Immediately after the initial vertical sawtooth, the positive retrace spike causes the blank- ing tube to conduct heavily. This re- duces the voltage on the first anode and cuts off the picture tube. The grid cur- rent which flows during the positive spike develops a negative bias which holds the blanking tube cut off during the following sawtooth portion of the sweep cycle. During this interval, the picture-tube first-anode voltage rises to normal and the screen is unblanked.

Fig. 6 shows the method of applying vertical- and horizontal-blanking sig- nals to the picture-tube cathode in the G-E 21T1-B receivers. The positive re- trace spike which occurs during the vertical-retrace period is shaped by C1, R1, and C2, and then applied to the cathode of the 21EP4 through C3. This positive blanking-signal voltage adds to the normal operating bias and cuts off the picture tube during the vertical- retrace period.

In this circuit, the horizontal blank- ing tube—one-half of a 12AX7—is a cathode follower which prevents feed- back and interaction between the ver- tical- and horizontal-output circuits. The positive horizontal-retrace spike is applied to the grid of the cathode fol- lower through a shaping network. The output of the blanking tube is tapped off the cathode and applied to the cath- ode of the picture tube to blank it dur- ing the horizontal-retrace period.

The method used for vertical-retrace blanking in the Du Mont RA-164 and RA-165 chassis is shown in Fig. 7. The negative blanking signal which is ap- plied to grid of the picture tube is obtained by applying a part of the ver- tical sweep voltage to a differentiating network (C1-R1) connected between the yoke and the grid. END

TV DX REPORTS

FEBRUARY will be a good month for the TV dx enthusiast to take a vaca- tion. At no other time of the year can he be so sure of not missing anything if he takes time off from his dx hunt- ing. February is one of the low spots of the year for sporadic-E dx. It is also a time of year when tropospheric propa- gation can be expected to be at a low ebb in nearly all sections of the country.

When tropospheric propagation is due to improve it will give ample warn- ing to the observer who has learned to correlate visible weather effects with reception conditions. If the weather is cold and windy, one can be almost cer- tain that there will be little or no tropospheric bending, as it takes stable calm weather for the necessary inver- sion to build up. Watch for gradually increasing cloudiness and moderating temperatures. Fog forming over areas of melting snow is a good sign, as is a steady high or slowly falling barom- eter.

Auroral displays are common in February over the more northerly parts of the country, and may be observed occasionally even as far south as Okla- homa and North Carolina. To check for aurora effects on TV reception the ob- server should have a high-gain antenna that can be aimed at the visible aurora. Displays characterized by vertical streaks of light are most likely to re- flect TV signals; the indefinite glow- type display is lower on the scale of interest. If the array is a Yagi or other narrow-band design, it will be useful for aurora work only on the channel for which it is cut, but it will be supe- rior on that channel to most other types.

If you have a station within 50 miles or so, the aurora may do little more than produce indefinite streaks across the picture, but if you have no local reception to block it out, dx up to sev- eral hundred miles *may* be possible. To be of greatest value, reports on TV reception during an aurora should give the exact time, the nature of the recep- tion observed, and, if possible, the ap- pearance of the auroral display at the time. Any evidence of aurora effect on high-band reception is important. END

HOW TO CHECK YOUR SIGNAL GENERATOR

Confidence in your test equipment can help you do better work in less time—Keep your generator "on the nose" with these simple tests

By LOUIS E. GARNER, JR.

ALTHOUGH the signal generator is one of the most important pieces of test equipment in the service shop, it is used so seldom compared with the multitester or tube tester that if a defect develops in the instrument, the technician may be completely unaware of the fact until the generator is needed for an important job.

You, as a technician, should check your signal generator at regular intervals, not only just to make sure the instrument is working, but to see that it performs all functions properly; that all controls operate in a normal manner; and that the calibration is accurate enough for any service requirement.

A block diagram typical of most service-type signal generators is given in Fig. 1. The controls usually found on such an instrument are as follows: *Power* switch (sometimes combined with another control); *range* switch (or *band* switch); *tuning; coarse attenuator* (or *step output); fine attenuator* (or *vernier output); audio output (modulation level* and *audio output* may be the same control); *modulation selector* (usually at least three positions . . . *r.f., mod. r.f., ext. mod.).* The instrument generally performs the following functions: *(a)* Supplies an unmodulated r.f. signal of variable frequency and amplitude. *(b)* Supplies an internally modulated r.f. signal of variable frequency and amplitude. *(c)* Supplies an externally modulated r.f. signal of variable frequency and amplitude. (*d*) Supplies an a.f. signal of fixed frequency but of variable amplitude.

Some signal generators may supply a variable-frequency a.f. signal as well. Others may also supply an adjustable d.c. voltage for use as a substitute a.v.c. voltage.

Regardless of individual circuit differences, the tests to be suggested will apply to most service-type instruments. The technician may easily modify the tests for special cases.

In making these tests, check the operation of every control on the instrument, as well as the performance of each function. When modifying the tests for special instruments, the list of typical controls and instrument functions given above should be helpful.

Attenuator operation

The actual output of the signal generator in microvolts is not important for most service work—*provided* sufficient signal is available when needed, and *provided* the signal can be attenuated easily. You need only check to see if sufficient signal is delivered for test purposes, and if the attenuators operate properly.

Any service-type instrument should deliver enough r.f. energy to drive an i.f. signal through a misaligned receiver. A quick test is to connect the generator-output cable to the antenna terminals of a table-model receiver. Use a *modulated r.f.* signal on the intermediate frequency of the set, and tune the receiver near the low-frequency end of the dial.

You should hear the modulating signal in the receiver loudspeaker when the signal-generator output is increased, regardless of the receiver dial setting (as long as the set is tuned near the low-frequency end of the broadcast band).

To check the operation of the attenuators, connect a v.t.v.m. or high-resistance d.c. voltmeter across the second-detector diode-load resistor in the receiver (Fig. 2), and measure the a.v.c. voltage as the attenuator controls are varied. The a.v.c. voltage should drop gradually as you reduce the generator output. If there is no noticeable change in a.v.c. voltage, one (or both) of the attenuator controls may be open.

Check the operation of the attenuators in this way not only at the receiver i.f., but also at several points in the broadcast band (and at other frequencies, if a multiband receiver is available).

Repeat this test with an unmodulated r.f. signal. When the modulation is switched off, the tone in the loudspeaker should disappear, but the a.v.c. voltage, as measured with the d.c. voltmeter, should remain unchanged. If the a.v.c. voltage disappears too, it may mean that the r.f. oscillator either shifts frequency appreciably when modulated or "drops out". In either case, repair the instrument.

Modulation tests

You can see the modulated-r.f. signal on a high-gain oscilloscope when the output of the signal generator is turn to maximum. Connect the generato output cable directly to the VERTIC INPUT terminals of the oscilloscope. S Fig. 3. Using a linear horizontal swe and with the scope controls adjust properly, you should see a pattern li the one in Fig. 4-a. The percentage modulation may be determined appro imately by direct observation, a should be between 30% and 40% f most signal generators. A few ge erators have provision for adjusting t percentage of modulation.

The exact modulation percentage not too important, as long as at lea 10% to 20% modulation is achieve and as long as there is no over-mod lation. See Fig. 4-b. If the maximu modulation obtainable is less than 20 the audio oscillator tube is probab weak, or some part in the modulat circuit has changed value. If the r carrier is over-modulated (Fig. 4-b it may mean that a part in the circu is defective, or that the r.f.-oscillat tube is weak. An inexpensive kit-ty scope has been used successfully to o serve modulated-r.f. signals from service-type signal generator as hi as 1600 kc. It is doubtful, though, th r.f. above the broadcast band can seen without a wide-band scope.

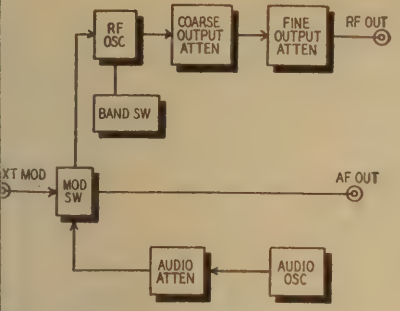
To check the EXTERNAL MODULATI function of the signal generator, repe the tests outlined above, taking t modulating signal from an audio cillator, or from a test record throu a phono pickup.

Checking audio output

Almost all signal generators desig for servicing have provision for usi the audio-frequency modulating sig as a separate output. This audio sig may be used for signal-injection tests receiver audio sections, or in testi phonograph amplifiers and PA syste

In most cases, the a.f. is a 400-cy signal, but many generators use ot frequencies, with a few having c tinuously variable audio oscillators.

Knowing the exact audio freque is unimportant for most test work, for distortion tests the audio wavefo must be a good sine wave. The out level should be high enough for around signal-injection tests, and sho be fully adjustable.



ig. 1—Block diagram of a typical serv-e-model signal generator. Some types ay also have tunable audio oscillators.

The audio waveform and the operaon of the output-level control may th be checked by applying the signal the VERTICAL INPUT terminals of an cilloscope and adjusting the scope ntrols to show two or three cycles of e signal. After checking to make sure good sine wave is obtained, vary the dio-output control and note the change amplitude. If there is no change, it ay indicate an open control.

If a good-quality sine wave is not tained, it generally indicates either a fective audio oscillator tube, or inrect bias or B voltages, although ny inexpensive signal generators ve normal nonsinusoidal audio output. The maximum amplitude of the audio nal should be checked either with a k-to-peak a.c. voltmeter, or with the pe and a voltage calibrator. To be able for checking output stages ditly, the audio signal should have a imum amplitude of 1 volt r.m.s. 82 volts peak-to-peak). Less than s indicates either a weak tube or normally low B voltages.

equency calibration

The tests thus far have been essenly *qualitative*, but the frequency bration of the r.f. oscillator dial st be checked for accuracy.

A multiband AM receiver may be d for comparing the generator sigwith a frequency standard. Use the MODULATED R.F. output of the signal erator and couple the output cable he antenna terminal of the receiver, ough a 10- to 50-μμf capacitor. If don't have a capacitor this small, st together two pieces of insulated kup wire about two or three inches —this makes a satisfactory gimk for loose coupling.

oints on the lower-frequency bands he signal generator may be checked eating their harmonics against the iers of local broadcast stations.

n oscilloscope, with the VERTICAL UT terminals connected across the iver volume control, will give a e accurate indication of zero beat will the ear.

une the receiver to a local broadcast ion near the low end of the broadband. As an example, let us say 0-kc station can be picked up.

eave the receiver on this frequency, tune the signal generator to zero at the following points: 100 kc

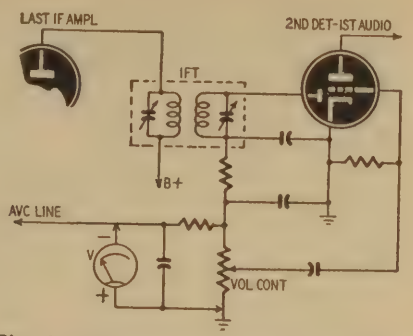


Fig. 2—Checking signal-generator output-attenuator operation with a v.t.v.m. or a high-resistance d.c. voltmeter, V.

(6th harmonic), 120 kc (5th harmonic), 150 kc (4th harmonic), 200 kc (3rd harmonic), and 300 kc (2nd harmonic). The 600-kc signal from the generator may be used directly for checking the 600-kc calibration point.

Any number of calibration points may be checked accurately against broadcast-station carriers in this way.

For generator frequencies in the broadcast band, it is not necessary to use harmonics of the signal generator, and the local stations may serve to give direct check points.

There are several methods of checking generator frequencies above the broadcast band. The choice of method depends primarily on local conditions and the technician's preference.

First, local short-wave stations (police, aircraft) will serve as satisfactory check points if they can be tuned in. WWV, if it can be picked up, provides accurate check points at 2.5, 5, 10, 15, 20, and 25 mc.

Second, a crystal-controlled spot-frequency signal generator will generally provide sufficiently strong harmonic signals to check quite a number of test points above the broadcast band.

Another signal generator, even if not too accurate, may be used to provide higher frequency test signals. The auxiliary generator is first zero-beat against a local broadcast station, preferably at the high-frequency end of the band. Next, the antenna is disconnected, and the signal generator under test is zero beat against harmonics of the auxiliary generator. As an example, if the auxiliary generator is first zero-beat against 1500 kc, using a local broadcast station as a standard, its harmonics may be used to check the generator being tested at 3 mc, 4.5 mc, 6 mc, 7.5 mc, 9 mc, 10.5 mc (note that this is quite close to the standard 10.7-mc i.f. for FM receivers), 12 mc, 13.5 mc, and 15 mc. If the auxiliary signal generator is especially strong in harmonics, even those above the tenth may be used.

In TV areas, an excellent and quite accurate 4.5-mc signal may be obtained by using the intercarrier beat in a TV receiver.

The results of these frequency tests will indicate if servicing of the instrument is required. The average signal generator should check within 1%, and accuracies of ½ of 1% are not too much to expect on better-grade instruments.

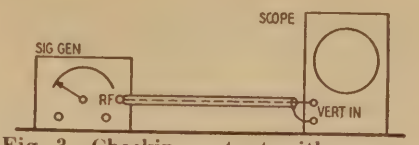
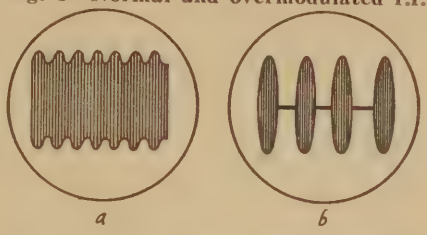


Fig. 3—Checking output with a scope.

Fig. 4—Normal and overmodulated r.f.



If the frequency error exceeds the tolerance at only one or two check points in any band, there is probably nothing that can be done easily to correct this condition, but a calibration chart can be made of the actual frequencies.

On the other hand, if a number of check points are off at one (or both) ends of a particular band, readjustment of the oscillator coils and trimmers may be in order.

If all frequencies are off in the same direction on every band, it may be that the dial pointer has simply shifted on the shaft. In this case, repositioning the pointer will restore calibration.

Unless the technician is familiar with the circuit of his instrument, and has had previous experience in adjusting and calibrating signal generators, he should turn over any major repair or recalibration job to a laboratory specializing in this type of work.

Maintenance hints

Even though the signal generator passes the tests outlined above with flying colors, you can insure longer life and more satisfactory operation for your equipment by adhering to certain rules in using it:

1. Leave the signal generator on during all normal working hours. This will keep the coils and circuit components dry and at an even temperature; improve the frequency stability; and the instrument is always ready for use.

2. Don't subject the instrument to mechanical abuse. Avoid extreme jars and don't attempt to turn controls past their normal limits (this is the usual cause of dial pointers shifting position). If the instrument must be used outside the shop, carry it in a padded or shockproof box (the original shipping carton is an excellent carrying case). Don't just drop it on the floor of a truck or throw it into the car trunk.

3. Avoid extremes in temperature. Don't use a hot radiator as a shelf for the instrument.

4. When replacing tubes, check the frequency calibration as outlined above. In some instruments, changing the r.f.-oscillator tube requires readjusting coils and trimmers.

5. Above all, remember that the signal generator is a reasonably delicate instrument and represents a real *cash investment*. Don't throw money away by abuse.

END

In TV service, it's always best to put one's BEST FOOT FORWARD

This view of the author's shop is convincin proof of the value of his statement

By JIM KIRK

IN ANOTHER article I spoke of the sign, "Goods Left Over 30 Days Will be Sold for Charges." You have seen the radio shop where your eyes are immediately assaulted by smart-alecky signs wherever you look. "Why be difficult, when with a little effort, you can be impossible?" "Do not ask questions, if we knew anything we would not be here." This sign is true—(if the shop owner knew anything, he wouldn't have hung it up!) "No credit. The world is coming to an end and I do not want to have to chase you all over H--l for my money." "Quiet! Genius at work." All plain warnings to would-be patrons, if I ever saw any!

In my many years in the radio business, I have made almost all the mistakes that one man could make, but thank my lucky stars, I never committed the blunder of putting up smart-alecky signs. Perhaps I go to the other extreme, because there are no signs whatsoever in my shop. I try to make the front room as attractive as possible. Years ago, I made the mistake of putting up three large red signs reading, "No Smoking" because I dislike the smell of burning tobacco. I took them down when a little thought showed me that I was insulting my customers. Now I have ash trays for smokers. If you want to put up the signs secured from manufacturers, I suggest you change them, now and then, and don't allow them to become dusty, faded, or torn. But I am not even having any of those *neat* signs.

A good criterion to follow is to ask yourself the question, "Would I do that in my own *home?*" I advocate making your shop as attractive as, or more attractive than your own home. After all, only you and a few friends see your home, while an attractive-appearing shop is a silent salesman, serving you without salary. Women, especially, are impressed by a neat, clean, new-looking shop. Need I remind you that the women comprise the majority of your patrons?

Last month, I took a critical look at my own establishment. The linoleum was worn in places. The woodwork was faded in spots. A workbench was in the front room. The bench looked all right except for two things. It is impossible to keep a bench uncluttered at all times and it is inadvisable (to say the least) to allow customers to see you work on their radios while they wait. It is poor psychology. If you do the work in a few minutes they ask, "You want money for that? It only took you a few seconds!" Or you might get a tough one, in which case the customer doubts that you know what you're about. In the early days, when I worked on radios while the customer waited, they used to look over my shoulder and say, "Don't look there for the trouble. The trouble is over here!" You can't win, either way! I've had customers insist that the speaker was defective because the set hummed or squealed!

To continue with the examination of my own shop. There was a junk can where old tubes and parts were throw I always return old parts to customer but they invariably say, "Throw the away." I also had an accumulation small parts.

I closed the shop for renovations. course, I lost some trade, but it paid o With a mighty effort, I took the repa bench apart and moved it to the re room. I now have two discard ca One is for hard scrap and one is f paper, cardboard and wood (materi that may be burned). But both rubbi cans are in the rear room. I bought n linoleum for the floor and repaint the woodwork.

In place of the bench, customers n see an electronic organ, flanked on ea side by magnetic tape recorders (whi I have for sale). There are two go paintings on the wall and a new uph stered chair with cushions, so invitin placed that customers gravitate to All this took some money and a gr deal of perspiration, but the results j tify the effort. Everyone remarks u the neat appearance.

Mothers who happen to come in w their children are immediately int ested in the musical instrument and recorders. Their little darlings can ways sing, so I offer to play the org and have their children sing for a t which I can play back, at once. T always makes a hit. Even if I ne sell a recorder, it makes for good- in my radio work. (The electronic or was home-built by taking all the nards" out of an upright piano

ostituting a rack and panels. The no keys are arranged to make elec-cal contacts. Control panels are un-neath the keyboard.)

Some may suspect that this room s "tidied up" for the picture but I ure you this is just the way I use room, every day. The recorders are open for demonstration and the plifier is always ready for use. The crophone on the stand is nondirec-nal and picks up the voice as well the organ. The mike can be plugged o either recorder or into the ampli-. When plugged into the amplifier, peaker in the rear room is actuated. e speaker is near the telephone so an play and sing over the telephone, necessary.

want to give customers the impres-n that I have nothing to sell but sets service. I remember how—when ad the service bench in the front m—customers would actually want "buy" three feet of wire or four ews and some tape or solder! I could say I didn't have any.

n the left end of the "library ch" I have a new Hickok tube tester h the cover always left on, both to p out dust and to conceal the me-nical appearance. I test tubes only en customers insist. It is my opinion t tube testing is not very profitable. encourages customers in the belief many have already, that nothing possibly go wrong with their sets pt tubes. When they insist, I point out that it is far better to bring the whole set in because some condition in the set might burn out a new tube. I also tell them I charge for testing tubes (I have no signs). I have had customers pay the tube-test charge and walk out saying they intended purchasing new tubes, at wholesale, elsewhere. I do have a large stock of new tubes (a necessity) but they are hidden from view in the rear room. The tube tester is seldom used in my service work. It is too slow. Continuity tests will show burnout, and substitution is much quicker than tube testing.

The picture, taken at night from the sidewalk, shows simplicity in window dressing. Note that no personal name or business name appears on the glass. Customers are interested only in *where* they may have their radios or TV's repaired. Among the photographs in my window is a photo of my little granddaughter playing a toy miniature electronic organ I built for her. All photographs are labeled and they attract attention. In one window is a framed diploma from a television school.

Several Christmases ago, I won the prize for the best Christmas decorations of any radio shop in San Francisco. I did not know I was competing until a committee appeared to make the award. There was a Christmas tree in each window decorated by strings of dial lights. They sparkled and twinkled much better than the orthodox Christmas tree lights. END

Another view of Mr. Kirk's reception room, showing the electronic organ and the recording equipment kept near it.

CATASTROPHIC TV?

By B. W. WELZ

I was relaxed in an easy chair watching the end of a movie on TV when Mr. Schultz phoned and told me he was getting channel 5. Nobody ever had got channel 5 in the hollow where he lived.

"Are you sure it's channel 5?" I asked, suspecting Mr. Schultz of imbibing strong refreshments to such extent that he was seeing wrong channels.

"KPIX, channel 5, San Francisco," he said. "I saw the call at the station break. I've been getting it for the past two weeks; but I can only get it after ten at night. And something else mysterious happens, too. Come out and I'll tell you about it."

Of course I was interested. Why was it that channel 5's signal had suddenly found its way to Mr. Schultz's antenna? What was the mystery he had referred to? These were only a few of the questions which assailed me as I drove to Mr. Schultz's home.

Mr. Schultz was getting channel 5, just as he had said. I stood in front of his set and scratched my head, trying to figure it out. "Did you touch the antenna lately?" I asked. "Did you move it or the lead-in?"

"A guy line was a little loose and I tightened it." Mr. Schultz replied. "I might have moved the antenna a few inches. But here's another thing—and this is very mysterious—sometimes I hear a cat cry at night, and when I do both picture and sound disappear. But only for a moment; they come right back." He looked at his watch. "It usually happens around this time every night."

This was too much. Cats crying and pictures disappearing. It looked like Mr. Schultz needed a spiritualist, not a television technician.

Then we heard a cat cry—a long, howling yowl, like cats at night on back fences. A window opened on a house halfway up the hill and someone leaned out and yelled at the cat.

"Look! The picture's gone!" Mr. Schultz said.

I looked at the blank screen. The window slammed on the house halfway up the hill—and the picture came back on the screen!

"Tell me," I asked Mr. Schultz after I had gotten over the surprise, "what kind of window have they got on that house on the hill?"

"They've got some new shutters with fancy brass design. . . ."

And then I had the answer to the puzzle. The shutter facing Schultz's house was open until ten at night, until someone closed it when they retired. When it was closed it reflected channel 5's signal to Mr. Schultz's antenna. When the cat made a disturbance someone opened the shutter and yelled at the cat—and Mr. Schultz lost his fine reflector. Strictly Rube Goldberg, but there it was. END

FIRE INSURANCE AND YOUR TV

Owner may collect for damage to home if fire starts in a TV set (or radio)

By H. L. MATSINGER

TELEVISION sets seem to burn, smolder, and smoke more readily than radio sets. If you are ever called on to examine one of these charred victims, you may be able to do your client an extra service, provided he carries fire insurance on home furnishings. With the right kind of insurance, there is no reason for the owner to be burned up in dissatisfaction after the set has burned.

The rule is that if a fire actually ensues, the insuring company is liable. Note the phrase *if a fire actually ensues.* This means that a fire must exist or have existed; that some part or parts of the set in question must actually *burn.* Mere charring from an overload, or gunk melting out of a transformer is not enough—*there must be a flame.* If there actually has been a flame, the insured can usually collect enough, depending on the age and original value of the set, to pay all the costs of a really good repair job. In addition, the owner can also file a claim for incidental damage to curtains, paint, wallpaper, rugs, and other household furnishings, under the terms of his regular fire insurance policy. These incidental claims can be based on damage due to the fire itself, the resulting smoke, the action of water or chemicals used to extinguish the fire, or the presence of firemen, in the event they are called in.

Before dwelling too long on the legal and technical aspects of potential claims, suppose I cite a couple of examples so you can get a better picture of what *does* and what *does not* constitute a valid claim. Nobody expects a service technician to be a part-time lawyer, and it is better to be on solid ground before you advise the set owner to contact his insurance broker, than to raise his hopes unduly. When you are right, the customer is going to love you for it; but if you happen to be mistaken, your client is going to feel awfully low. It is better to be overcautious than too optimistic.

First, let's consider the case of Edward Rosenzweig, of Philadelphia. Mr. Rosenzweig is a neighbor of mine, and one evening recently he dashed into my house all excited. It was after eleven, but since it seemed to be an emergency case, I grabbed my kit and followed him to his home. The place was filled with blue hazy smoke, not the kind you get from an overheated transformer, but more like the kind that comes from burning plastic insulation or capacitor wax. The set smelled as though it sure enough had been burning. When I turned it on, I could get a horizontal trace, and, by jiggling the controls, a complete, but blurry, raster. There was no picture, but the sound was O.K. The set had been tuned to one of those programs where the picture is not an absolute necessity, while the family was in the kitchen. The program blared on, and suddenly they realized that the kitchen was full of smoke. Rushing i the living room, they found smoke po ing out of the receiver. Mr. Rosenzw pulled the plug, then came over a me.

Late as it was, I pulled the chas and found that the fire had apparer started at or near the focus control the rear apron, had consumed sev nearby capacitors, and had even t eled along the leads of the vertical put transformer. Fortunately, t leads were dressed away from chassis, and there was no short circ Gunk was dripping from the horizon output screen and cathode capacit The .05-μf capacitor across the w coil and terminals 5 and 6 of the back transformer was comple burned away, leaving only two pigt

RADIO·TV·AUDIO SERVICING — GRANITE 4-6148 — ELECTRONIC DESIGNING

H. L. MATSINGER, B. S.
Electronic Specialist
6134 SPRUCE ST., PHILA. 39, PA.

Estimate for the complete repair of Brunswick Model 6165 Television Chassis partially destroyed by an under-chassis fire originating in the Hor. Output circuit, and destroying most of the Hor. and Vertical synchronizing components. Set located at 6133 Spruce Street.

Replace the following parts:-

2 Filter Capacitors	4mfd. 450v	@$ 2.25	4.50
7 Ceramic Cap. Tem. Comp.		@$ .40	2.80
1 Hi-Volt Capacitor		@$ 1.75	1.75
6 Moulded Paper By-Passes		@$ .35	2.10
8 Carbon Resistors 20% Tol.		@$ .15	1.20
2 Carbon Resistors 5%		@$ .20	.40
1 Focus Control 1500 ohm Wire Wound		@$ 1.65	1.65
1 Comb. Hor. & Vert. Hold Control		@$ 3.25	3.25
1 Comb. Contrast and Brightness Control		@$ 3.65	3.65
2 Peaking Coils		@$ .90	1.80
1 Hor. Blocking Trans.		@$ 3.10	3.10
1 Hor. Output Trans.		@$14.00	14.00
1 Vertical Blocking Trans.		@$ 2.55	2.55
1 Vertical Output Trans.		@$ 4.25	4.25
1 6W4GT Damper Tube		@$ 2.00	2.00
1 1B3GT HV Rectifier		@$ 2.75	2.75
1 6BG6G Hor. Output Tube		@$ 5.00	5.00
2 6SN7GT Hor. and Vert. Osc. Tubes		@$ 2.42	4.84
1 6AL5 Hor. Phase Tube		@$ 2.00	2.00
1 Focus Coil		@$10.25	10.25
	Total cost of parts		$73.84

Estimated labor costs for installing new parts, aligning, adjusting, and setting controls for proper operation---------- $45.00

TOTAL AMOUNT OF ESTIMATE----------$118.84

This estimate given 4 August 1952, and is effective for thirty days after date.

H. L. Matsinger

A sample technician's estimate—*completely itemized*—of material and lab charges required to repair a television receiver damaged by an internal fi

tending from the connections, and a arred capacitor body lying on the binet shelf. Naturally, they asked for estimate, which I gave them, and ey wanted me to take the chassis away ght then and there. I suggested that ey call their insurance broker first, d get his opinion before I removed e chassis. To make a long story short, e insurance company settled for $100, ough to replace all doubtful parts, d to pay for a really good repair job.

This was one case where a *legitimate im* was filed *within a reasonable time*, hich paid off. Now let me tell you an- ner story which does not have such a ppy ending. Mr. and Mrs. Stalker, South Wilton Street in Philadelphia, re watching a television program in eir home one evening when suddenly mes shot out the back of the cabinet. . Stalker, with rare presence of mind, st pulled out the line plug, then used the television set with water. put out the fire, but in doing so he attered the wallpaper and soaked the g. They had the store from which ey bought the set pick it up and re- ir it, never thinking about insurance verage for the damage done. The re- irs cost them $25, and they still have veral ugly stains on the wallpaper, as ll as a matted spot in the rug. When came into the picture a couple of nths later, and told them of their hts, they made a claim, but it was allowed. They had waited too long to the claim, and the supporting evi- nce was gone.

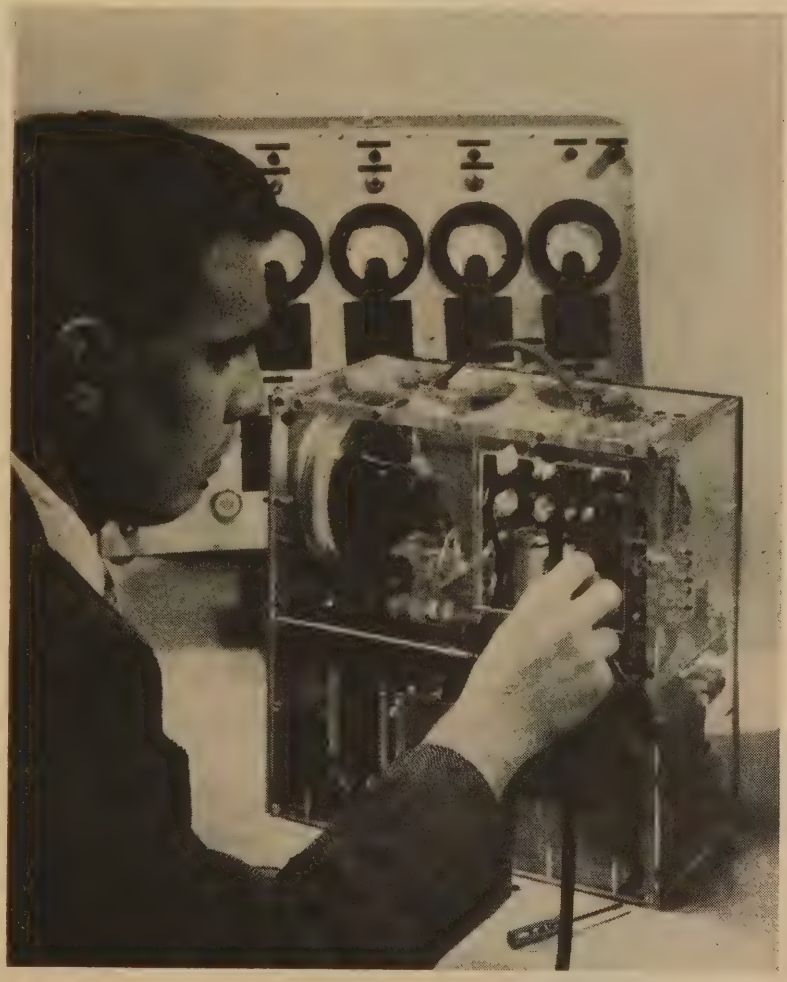
To illustrate another situation in ich one cannot collect, let me tell you story of Mrs. L. M. C., of Camden, J. Mrs. C. has, or had, one of those luxe RCA 7T models, with the 547F-2 chassis, and all the trim- ngs. She paid a pretty penny for the , and had the regular factory in- llation. She had ample insurance erage, yet, through one of those xes, her type of loss did not qualify. s. C's antenna was struck by light- g. High voltages surged down the d-in, apparently bypassed the light- g arrester, and fused a number of ts in the tuner. When the parts ed, they caused short circuits which w several tubes, *but no fire resulted.* der the extended-coverage provision ner insurance policy, Mrs. C will col- $30 for erecting and installing a antenna, but the other repairs are own liability.

These three examples should give you retty good idea of the requirements a legitimate claim. All claims, urally, are subject to examination by company's adjuster, but in any nt, some payment will be made to pay the costs of repairs if the m is valid. You can help your cus- er, and earn his good will by doing things: First—remove everything might interfere with a ready ex- nation of the part or parts affected, he insurance adjuster can see the nt of the damage. Second—prepare honest estimate of the cost of re- placing all parts *even slightly damaged*, including your labor costs. Do this even though you feel that some parts may still be usable—the company may settle for these at a discount. The estimate should be on your business letterhead, and in duplicate. You can tell your customer about the importance of making a claim for damage to walls, floors, rugs, and other furnishings, but this is not your responsibility. In doing this, you are merely acting as a friendly advisor.

As you have probably grasped by now, the fire can be large or small, under the chassis or on top, as long as there really is a blaze. It is not necessary for the cabinet or any surrounding part to burn, as long as *something* burns. You should not remove the chassis from the house until it has been examined by an insurance adjuster, since you may prejudice the claim. Then too, *you* want to be protected, in case the claim is disallowed and the owner will not guarantee payment. A situation of this kind may develop if the fire was caused by lightning striking an antenna which was not properly grounded through a UL-approved lightning arrestor. Disclaimers of this kind do not happen often, but if the damage is extensive the company might seek an out, so play it safe.

One more point: Be sure to collect for your service call. The set owner may use the insurance money to buy a new set. If he does, don't consider him ungrateful, it is only human nature not to want an item which has gone bad. Just see that you are paid for your calls so you will be square with him no matter what action he takes. If you sell sets, or have a tie-in with a house that does, maybe you can sell him the new one. You may even be able to buy the old television set at a reasonable figure, repair it, and sell it at a profit. END

ALL-TRANSISTOR TV RECEIVER SHOWN BY RCA



Tubeless—except for its 5-inch kinescope—this all-transistor portable TV receiver was one of the highlights of the recent RCA symposium on transistor progress. Some of the 22-odd experimental plug-in transistors which replace tubes throughout the set can be seen above the hand of RCA engineer Gerald B. Herzog. No larger than a portable typewriter, the experimental one-channel battery-operated receiver gives good pictures at a range of 5 miles on its built-in loop, and at 15 miles on a "rabbit-ears" antenna. The set weighs 27 pounds.

Service technicians and dealers: These recent court decisions may help safeguard you against loss

A reader recently asked: "If a pur chaser signs a contract wit a dealer for the installation a television set, can the deale recover damages if the purchaser re scinds the contract, and, if so, ho much damages may the contractor re ceive? If the customer denies that h signed the installation contract wha is the proper legal procedure for th contractor?"

The answers to these legal questio are given in a recent higher-court d cision and should help TV and a pliance dealers, technicians, and di tributors to win suits of this nature.

Customers' liability

In the case of Krumholz *v.* Rusa 41 N.W. (2d) 177, the testimony showe that a dealer signed a contract with purchaser to install certain equipme in his home.

The purchaser later refused to allo the seller to install the equipment, a the seller sued to recover the profit would have earned on the job had t purchaser not rescinded the contra

The jury considered all testimo and held the purchaser liable for $84

By LEO T. PARKER

WHO

the profit the seller would have earn had the contract been completed.

If a purchaser breaches a contra for installation of a television set, t dealer may sue and recover the a ticipated profits which he would ha earned by fulfilling his part of t contract.

Lessor liable

Another reader asked this questio "Very often I lease out television s with privilege of purchase by the c tomer. By this plan I get the custo to try out my set without any financ loss. How can I protect myself agai theft or other damage to a televis set I lease to a customer under a 'pr lege-of-purchase' contract?"

A new higher-court decision clea answers this question:

In Perreault *v.* Circle Club, 95 N (2d) 204, the testimony showed following facts: A dealer leased Circle Club a television set for month at a rental of $150 a mo with an option to buy it for $1,721 The lease contained the following p vision: *"The lessee shall pay for damage* to the equipment during term hereof or while the same is in actual possession or constructive p session, which may be due other than to ordinary wear and tear incid to the normal use thereof, and at termination of this agreement, by expiration of the terms hereof or ot

e, the lessee shall surrender to the
or the said equipment in good order,
air and condition in all respects,
sonable wear and tear excepted."
few days after the set was in-
led some one broke into the premises
the Circle Club and stole the set,
nout negligence or other fault on
part of the Club.
he dealer sued the Club to recover
71.25, ($1,721.25 less the one-month
al of $150 already paid).
he higher court held the Club liable
he dealer for $1,571.25.
he court explained that if the Circle
had not signed a contract contain-
the clause above, it would not have
liable to the dealer for any pay-
t unless the dealer had convinced
court that the theft of the set re-
ed from some fault or negligence of
Circle Club.
nerefore, dealers who lease sets, or
e them in homes on approval,
ld protect themselves against loss,
age, or theft of the sets by having
customers sign an agreement con-
ng the full text of this damage
e plus any other protective clauses
attorney thinks necessary.

was to devote his services to the business; that Pruyn's equipment and stock was worth $2,500; that 50 percent of the gross receipts of the business would be deposited in a bank account until Pruyn received $2,500 as repayment; that thereafter a fund of at least $1,000 was to be maintained, and that the excess was to be divided equally between Pruyn and Nuland. The higher court held that no valid partnership agreement existed because the testimony did not prove conclusively that Pruyn and Nuland were to *share both profits and losses.*

Mechanic's liens

Generally speaking, the law is well settled in all states that a properly recorded chattel mortgage is superior to a technician's mechanic's lien on a television set. However, a higher court recently held that a mechanic's lien is superior to a mortgage which was not recorded, and where the technician had no knowledge of the existence of the mortgage.

In Christian *v.* Boyd, 222 S.W. (2d) 157, a purchaser gave a dealer a note and chattel mortgage for the balance due on the equipment purchased. This mortgage was *not* recorded. Some time later a technician repaired the equipment, and the purchaser failed to pay the bill for materials and labor.

Since the testimony showed that the technician had no knowledge that the mortgage existed, the higher court held that the technician could take possession of the equipment to secure payment of his bill.

The court explained that if the mortgage had been recorded, it would have been superior to the technician's lien, and the technician could not have taken possession of the equipment.

A recorded chattel mortgage constitutes legal notice to the public that a lien exists. Many small-loan companies require that the borrower execute a chattel mortgage on his household possessions, and if you have any doubt about the set-owner's ability to pay, it is advisable to check up before you undertake any expensive repair jobs.

What lien must cover

Considerable discussion arises from time to time over the legal question: "What charges does a mechanic's lien cover?" According to a higher-court decision—Eastex Finance Company *v.* Bryant, 42 So. (2d) 418—a technician *cannot* have a valid mechanic's lien to secure payment of *any* charges, unless the amount of the bill includes *both labor and materials.*

A technician filed a mechanic's lien against equipment to recover $350. Since the bill was for accessories, and did not include a labor charge, the higher court held the lien void and said:

"The Service Station *could have no lien* for the price or value of any items or any accessories *sold* by the said Service Station in the regular course of business, *where no labor was both performed and charged for* in the installation of such accessories."

For comparison, see Funchess *v.* Pennington, 39 So. (2d) 1. Here the court held that a technician claiming a lien for labor and materials furnished in repairing a television set has the burden of proving that he supplied *both labor and materials.* This court explained that if the technician made a charge for *installing* repair parts and accessories he can have a valid mechanic's lien on the set to secure payment for the parts, *plus* the labor charge.

Station licensing

A higher court recently decided that the Federal Communications Commission has jurisdiction to extend the time allowed for construction of a television station. In other words, failure of a company to complete construction of a station within the time specified in the permit will not forfeit its right to complete the work where the Commission grants an extension of time.

For example, in United *v.* Federal Communications Commission, 178 Fed. Rep. (2d) 700, it was shown that the United Detroit Theatres Corporation applied for a six-month construction permit for a television station in Detroit, Michigan. The corporation found it would not be able to complete the station in six months and applied for an extension of time. The Commission granted the application without a hearing.

In the meantime another company applied to the Commission for a permit to operate a television station on the same channel previously awarded the United Detroit Theatres Corporation.

In subsequent litigation the higher court upheld the Commission's decision in retaining the channel for the United Detroit Theatres Corporation, saying:

"The failure of the Commission to consider appellant's (United Detroit Theatre Corporation's) application in its normal routine turn was within permissive administrative discretion ... if there remain available (television) channels to which the applicant may be assigned."

END

S LIABLE?

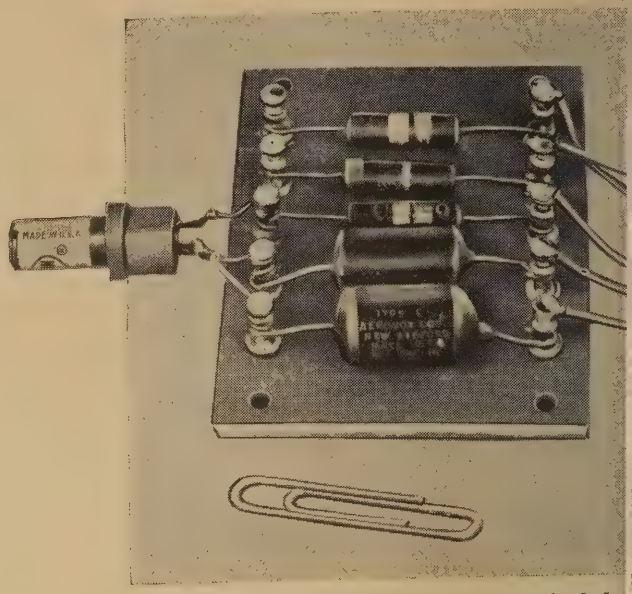
nicians' liability

cording to a late higher-court
on, a television technician is liable
ll losses resulting from his neg-
installation of television sets
ther equipment.
Russell *v.* Union Company, 191
(2d) 278, a property owner sued
hnician to recover damages for
struction of his dwelling by fire.
roperty owner proved that after
chnician had installed the tele-
equipment, together with the
ary wiring and electrical con-
ns, his house caught fire and
l down. The technician had cut
wer-line insulation, exposing the
nd then used uninsulated, sharp-
staples in securing the wiring
parts of the interior of the dwell-
he jury held the technician *liable*
e full value of the dwelling and
tents, and the higher court ap-
the verdict.

f partnership

ern higher courts consistently
hat a valid partnership never
unless the partners agree to
oth losses and profits.
illustration, in Nuland *v.* Pruyn,
ac. (2d) 261, the testimony
t out these facts: Pruyn owned
and television repair service
s. Nuland represented that he
expert radio service technician.
ade an agreement that Nuland

a TRANSISTOR PRE-AMP



A complete preamplifier on a 2½ x 2-inch bo

By RUFUS P. TURNER, K6AI

THE new Raytheon CK716 point-contact transistor provides higher voltage gain in simple circuits than the CK703, which appeared several years ago. The CK716 is a small 2-pin plug-in unit, 0.65 inch long and 0.255 inch in diameter. One of the photos shows a group of CK716's with the Cinch type 8749 subminiature sockets which have been designed for them. The two pins of the CK716 connect to the emitter and collector electrodes. The brass shell of the unit is the *base* ("cathode") terminal. The sockets are keyed to prevent accidental insertion of the pins in the wrong holes.

An interesting practical application of this transistor, which makes use of the available gain, is a miniature pre-amplifier. This unit may be used in audio amplification and preamplification and in various types of instrumentation in which the low input impedance (approximately 550 ohms at 1,000 cycles) is not objectionable and the high-impedance output is satisfactory.

As built by the author, the circuit components are mounted on a 2½ x 2-inch terminal board (see photo). This does not represent, by far, the ultimate in miniaturization. The entire amplifier, for example, might be packaged in a small can for insertion in a cable.

Two circuits may be used. Both are *grounded-base* amplifiers. Fig. 1 shows a fixed-bias arrangement which has somewhat higher voltage gain than the self-biased circuit of Fig. 2. The circuit in Fig. 1 gives flat response within 1½ db from 20 to 25,000 cycles, has a linear output-*vs*-input voltage characteristic, and provides a voltage gain of 50 when working into a circuit of not less than 100,000 ohms impedance. Maximum input signal voltage is 0.1 volt r.m.s. and maximum output signal voltage is 5 volts r.m.s. sine wave. With no input signal voltage and with the input terminals open, output noise level is 0.015 volts r.m.s. (50.5 db below maximum signal voltage output). Miniature 1½- and 67½-volt batteries are used. The d.c. collector current is 1.3 ma. The 1½-volt bias source must supply 0.55 ma. This low drain insures long battery life. If desired, standard power supplies may be used instead of batteries.

The circuit in Fig. 2 employs a 650-ohm base resistor, R2. Voltage gain of this circuit is 46. Maximum signal input is 0.1 volt r.m.s., and maximum signal output 4.6 volts r.m.s. sine wave. A single 30-volt hearing-aid battery powers this circuit, although a power supply may be used instead, when desired. Current drain is 2.1 ma. d.c. A bypass capacitor across resistor R2 provided no detectable advantage. The circuit exhibited none of the usual tendency to oscillate as a result of external base resistance. Output noise level, with no signal input and the input terminals open, is approximately 0.02 volt r.m.s.

The coupling capacitors (C1 and C2 in each circuit) are 0.25-μf 200-volt miniature metallized paper units (Aerovox *Aerolite*). The resistors shown in the photo are ½-watt, but smaller-sized ⅓-watt, components are adequate. All wiring between terminals is done under the board.

It is not possible to cascade grounded-base resistance-coupled amplifiers of this type advantageously to obtain higher voltage gain. This is because the high output impedance of one stage must work into the low input impedance of the following stage, resulting in a voltage reduction which is only slig compensated for in the normal vol gain of the second stage.

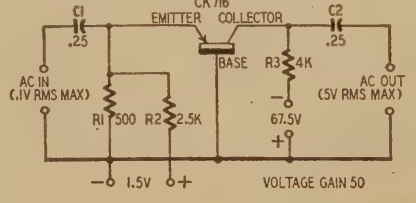
The maximum voltage gains o and 46 for the circuits in Figs. 1 2 are realized only when the amp feeds into a high impedance or re ance, at least 100,000 ohms. This i problem when the unit is oper ahead of a tube amplifier, a.c. vac tube voltmeter, electron-ray indic tube, or crystal headphones.

Materials for preamplifier

For either preamplifier: 1 CK716 transistor. 1 8749 socket or equivalent. Terminal board or mounting, wire, etc. For fixed-bias amplifie 0.25-μf metallized paper capacitors; 1—50 2,500, 1—4,000-ohm, ½-watt resistors; 1—1½ 1—67½-volt dry battery.

For self-biased amplifier: 2—0.25-μf met paper capacitors; 1—650, 1—1,000, 1—6,00 ½-watt resistors; 1—30-volt dry battery.

For less voltage reduction in cading stages, interstage transfor must be used. However, the purpo this amplifier is to use the tran gain at maximum efficiency in a s simple, inexpensive stage.



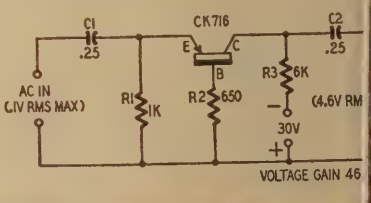
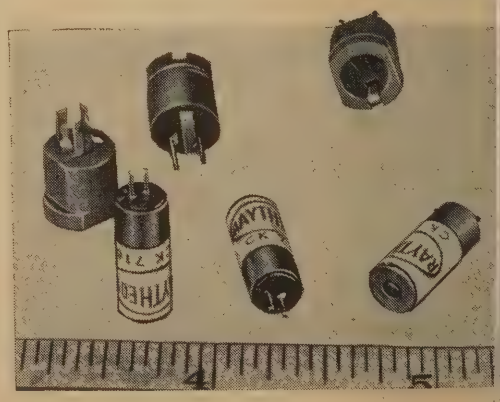


Fig. 1 (above left)—A fixed-bias transistor amplifier.

Fig. 2 (above right)—Transistor amplifier with circuit arrangement for self bias.

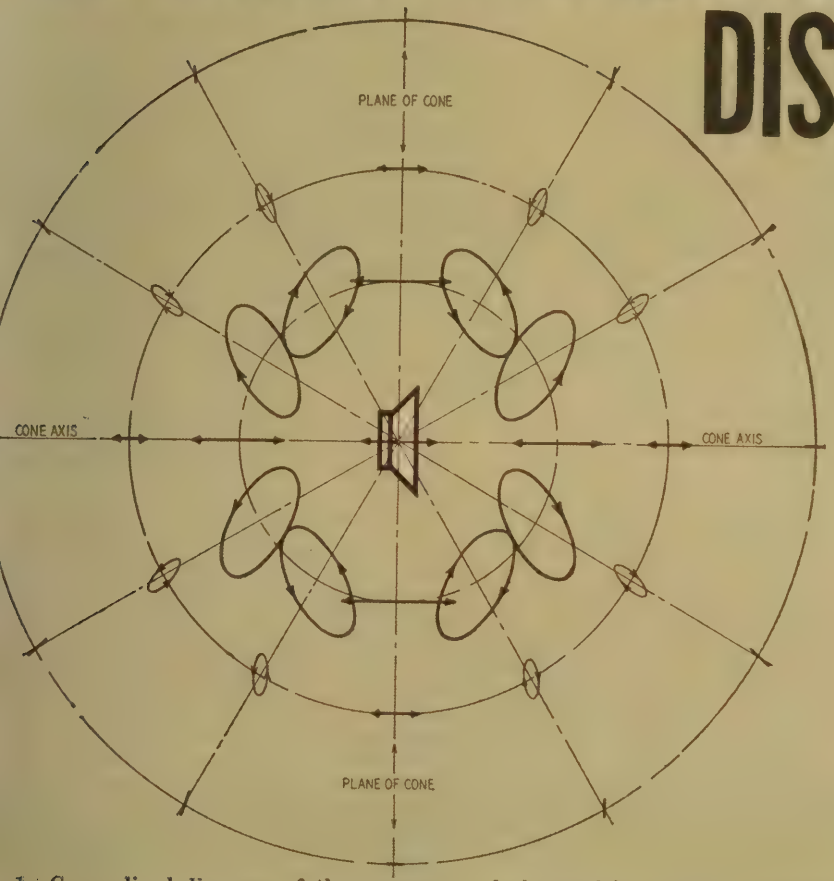
Photo (right)—A few type CK716 commercial transistors with matching sockets.



SPEAKER PHASING and DISSOCIATION EFFECT

By N. H. CROWHURST

Keeping the apparent sound source in the correct place calls for careful phasing checks



. 1—Generalized diagram of the movement of air particles around a speaker.

IS evident from correspondence the uthor has received since his article Loudspeaker Crossover Design" ap- eared in the July issue of RADIO-CTRONICS, that many people have gnized the phenomenon called "dis- ation effect" without fully under- ding its mechanism.

o understand the behavior of sound es we must have the relative wave- ths of audio frequencies clearly in d. Acoustic waves travel approxi- ely 1,100 feet per second in free air he length of one wave at a fre- cy of 1,000 cycles is a little over ot. Lower frequencies have longer es, while the wavelengths at higher uencies are shorter.

sense of direction

ext we must see how it is possible us—equipped with only two ears— etermine the direction from which und originates. A single ear can only a limited sense of direction use the spiral communicating chan- between the outer ear and the anism of the inner ear eliminates external directivity. Directional tivity must be a function of the preting faculty of the brain de- by comparing the nerve impulses *ved from both ears.*

Is this ability to discriminate based on the *intensity* relationship or on the *phase* relationship between the two ears? The difference in intensity between sounds reaching the two ears from a given direction in free space depends on the obstructing effect (diffraction) of the head. This effect increases with frequency, so the intensity on one side is greater at high frequencies than at low frequencies. The *phase difference* is also greater at high frequencies, because low-frequency waves are much longer than high-frequency waves and change less in the short interval between their times of arrival at the two ears. So the fact that we are more sensitive to the direction of origin of sounds at higher frequencies can be explained by either the intensity-difference or the phase-difference theories. Our subconscious probably utilizes both effects to some degree, but the *dissociation effect* makes it quite evident that the *phase relationship* between sounds received by our two ears is the more important of the two.

To prove this, we need to understand a little more about sound waves and their propagation. It is well known that a cone loudspeaker working without any kind of baffle or cabinet loses its effectiveness at low frequencies because air escapes around the edge of the cone. (When the cone is moving *forward*, air particles around the rim rush *backward* into the partial vacuum behind the speaker.) But what happens to other air particles farther away from the speaker?

Fig. 1 is a diagram of air-particle movement (somewhat exaggerated) at various points surrounding the speaker. Particles along the *cone axis* move back and forth along straight lines radiating from the source. On either side of the axis the particles spin in elliptical paths which grow shorter and narrower as the distance from the speaker increases. At extreme distances these ellipses flatten to straight lines which also radiate from the center of the cone. Note, however, that at points *along the plane of the cone* the particles move *at right angles* to the radius line, so that the sound at these points seems to come from left and right instead of from directly in front of the listener. (Under ideal conditions, the sound waves from left and right would cancel, so that no sound would be heard along the plane of the cone.)

How does this affect our sense of direction? Try listening to a speaker from different positions. You will find that anywhere—except for a small

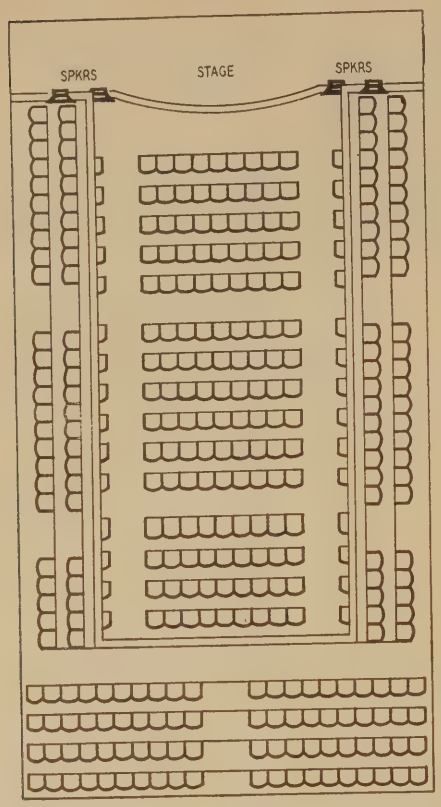


Fig. 2—Plan of auditorium that presented a serious problem in acoustics. Proper phasing of speakers solved it.

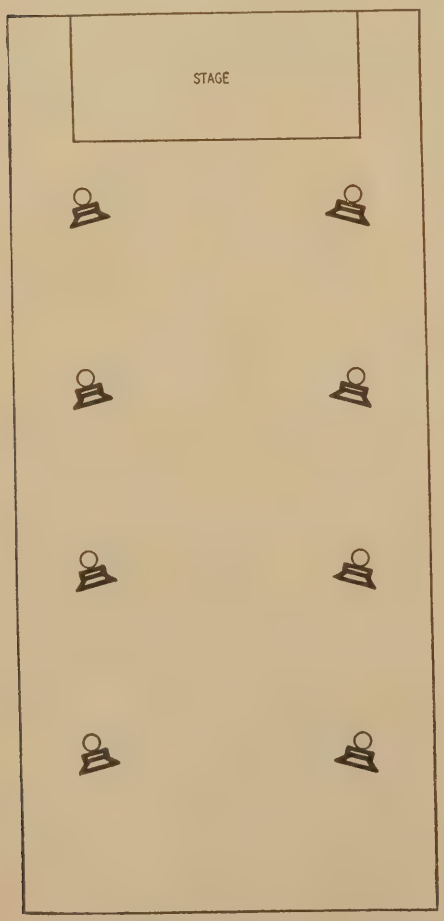


Fig. 3—Another speaker layout that calls for a special phasing technique.

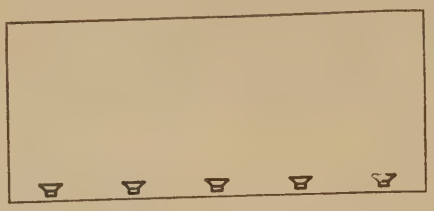


Fig. 4—Side-by-side speakers can create problems unless carefully phased.

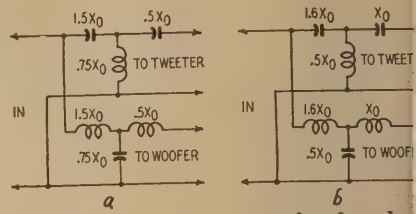


Fig. 5—Crossover networks for dua speaker systems. See text for derivatio

region near the plane of the cone, the source of sound is easily identifiable with the speaker unit. In the plane of the cone, however, the *dissociation effect* becomes noticeable and it is almost impossible to say where the sound comes from. When the dissociation effect is greatest, you get the impression that, instead of having a *single speaker unit in front of you,* there are *two similar units, one on each side.*

Phasing

The article in the July issue gave as an example two identical speakers mounted side by side with the listener standing on the center line facing the two units. When the speakers are connected *in phase* the sound seems to come from a point midway between them; but when they are *out of phase,* the sound seems to come from one side or the other. What does this tell us? With two identical speakers and with the listener at equal distances from both, it is obvious that both ears will receive sounds of equal *intensity.* But in one case the apparent source is readily identified as being in front of the listener, while in the other case the apparent source is somewhat indefinitely identified as being on both sides of the listener. If *intensity* were the only factor responsible for our sense of direction, we could not detect this change in phasing. This experiment shows that *relative phase* at the two ears is the important factor.

A similar effect can be noticed if the loudspeakers are mounted some distance apart, and the listener is an even greater distance away on the center line. If connections to one speaker are reversed and the listener moves off center, the phase patterns from the two speakers will gradually fall into line and cancel. At a greater distance off center there should be another anti-phase position, but by the time this position is reached, the *intensity* of the sound from the nearer speaker is sufficiently greater than that from the more distant one so as to nullify the dissociation effect, and the nearer speaker now seems to be the source.

Phasing in PA work

Having investigated the matter so far, we can ask the question, "Is loudspeaker phasing important for PA work?" The answer is definitely *yes.* The author remembers one job where phasing played an important part. Fig. 2 shows the layout of the installation. The auditorium was a long, narrow rectangle, with the stage at one end. The only points where speakers cou be mounted were at the sides of t stage and immediately above it, the ends of the narrow sections of t gallery. An engineer who did not re ize the possible consequences had si ply connected the four speakers parallel without regard to phasing. T hall was acoustically poor due to natural echo, but it *was* symmetric and he could not understand why was extra bad at certain spots especi ly along the right-hand side. We su gested that two of the speakers be c connected, and observations of the ty described above be conducted on t center line. Similar tests were th made with the other speaker pair. found that one speaker on the rig hand side had been connected out phase with the other three. Revers the offending speaker not only impro the bad spots, but made listening c siderably better everywhere at the b of the hall. The natural echoes w still evident, but not to such a deg as to render sound almost unintel ible. The incorrectly phased spea had introduced some echo effects of own, which made listening even m difficult, except where the listener comparatively close to one speaker u

Extended investigation on other stallations has shown that it alw pays to check speaker phasing. It be thought that where speakers arranged as in Fig. 3 correct pha between symmetrical pairs would important, but not between other u at different distances from the f of the hall. Tests show that there is really effective method of connec and this is invariably with co phasing. The explanation seems t that when a listener hears sound f two sources, one of which is ne than the other—as must happen in s positions with an installation of type—the nearer source gives the pression of a direct sound, while sound from the more distant sour like an echo. Where the echo ar long enough after the direct sour be distinguishable from it, phasi unimportant, but there are always positions where the two sounds a so close together that the ear ca distinguish them as separate so At such positions, phasing can an important difference.

Another type of installation is s in Fig. 4; correct phasing is ver portant here. Walk around the ba the room while sound is being b cast: when nearer to one speake sound seems to come from the vi

his speaker; at a point equidistant n two speakers, if the two are *in se*, the apparent source of sound ns to pass smoothly from one speak- o the other; but if they are *incor- ly phased* there will be an area of used sound where the building echo ns emphasized, often to the point of telligibility.

ssovers

issociation effect can also occur dual speaker units fed from an rical crossover network, but the t is slightly different from the ious examples. You get the impres- that one part of the frequency trum has a source different from remainder of the spectrum. In large -speaker installations, such as in e theaters, this dissociation effect be swamped by the natural rever- tion of the auditorium. However, ffect can be quite disconcerting in equipment, giving the sound an tural quality that many listeners complained of.

g. 5 shows two typical loudspeaker over networks, and Fig. 6 gives phase characteristics. Although wo networks have identical sche- configurations, the one shown in 5-a has values chosen to provide ant resistance, while the network g. 5-b uses typical wave-filter-de- values. To make the distinction en the two types clearer, com- t values have been marked in of their reactances at the cross- frequency, X_o being a reactance to the characteristic impedance e crossover point.

e top and center "A" curves in 6 show the phase responses of the frequency and low-frequency sec- of the constant-resistance-type rk. These have a constant phase ence of 270° over the entire fre- y range, as indicated by the solid A" at the botton. On the other the high-frequency and low-fre- y sections of the wave-filter-de- network have a phase difference

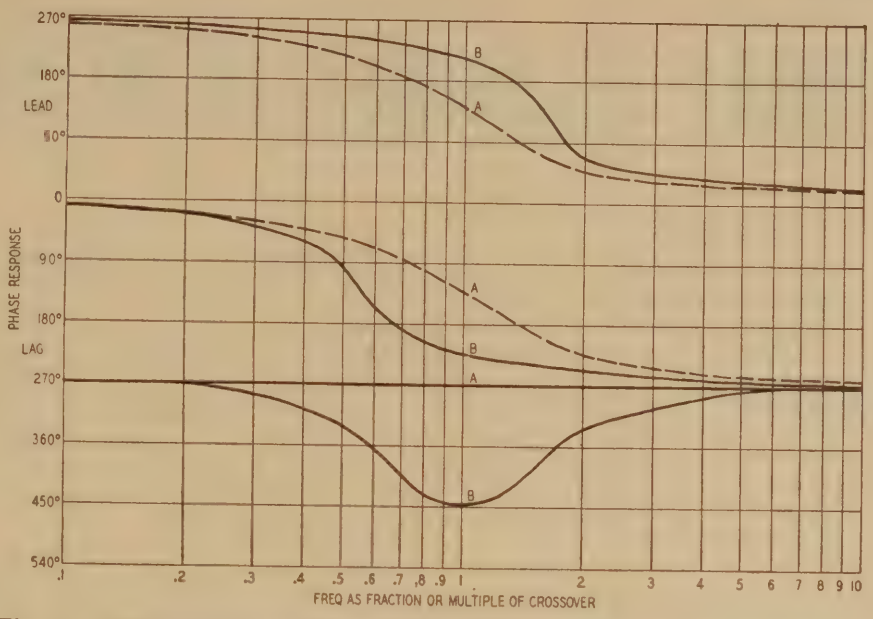


Fig. 6—Crossover-network phase relations. "A" curves are for constant-resistance networks; "B" curves for wave-filter type. Top and center curves show high- and low-frequency shifts, respectively; curves at bottom show phase differences between high- and low-frequency units over entire range.

of 270° only at the extreme limits of the frequency range, while the difference between them increases to almost 450° at the crossover frequency (curve "B" at the bottom).

With this type of crossover network, no matter how the h.f. and l.f. units are connected in an attempt to maintain constant phase difference between them at or near the crossover frequency—there will always be a rapid deviation from the constant-difference condition near the crossover point. As a result, some component frequencies of the reproduced sound will have their apparent sources shifted to one side or the other, away from the general apparent source of the speaker combination.

If we are trying to reproduce a musical tone which contains a series of harmonics extending through the crossover frequency, this type of network will move the apparent sources of some of the harmonics to positions a small distance away from the common source of the others.

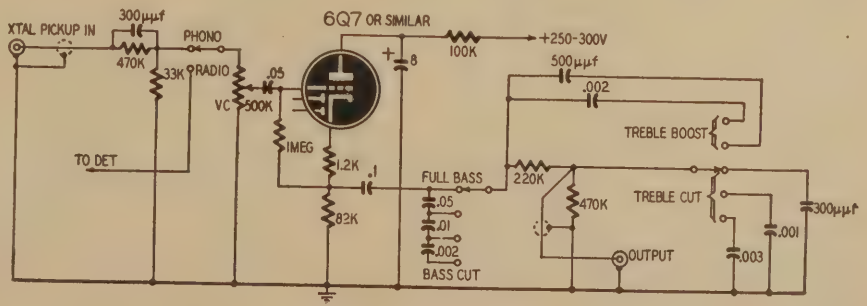
Before concluding it is perhaps well to emphasize one point on the question of phase difference that seems to confuse a number of readers. In electrical circuits, phase difference is essentially a *time difference*, measured in degrees over the duration of one cycle at the frequency considered. The acoustic effect on which our ears base their directional deductions is better understood as the *slope* of the wave in space, *at any particular instant in time*, and is thus a kind of *spatial* phase difference. This distinction may help some who find it difficult to see why two interacting acoustic fields which differ in phase can produce effects noticeable to the ear, even though *electrical* phase differences of much greater extent are not normally detectable. END

ADDING BASS AND TREBLE CONTROLS TO HI-FI TUNER OUTPUT

h an ever-increasing interest in fidelity, many music lovers are ting standard AM and FM re- into tuners for use with high- amplifiers. Usually the receiver cation includes the addition of nd treble controls and a cathode er to reduce the output impedance. diagram shows the cathode fol- and equalization circuit used in tput of a broadcast tuner de- in *Radio Constructor* (London, d). In most circuits, we can ex- find one or two stages of audio cation between the signal source e tone controls. In this circuit, ne controls are at a low-level The cathode follower provides a nput impedance to the volume which is a part of the detector nd acts as a buffer between the ircuit and the tone controls.

The bass control has four positions. One permits full bass response, the other three progressively reduce the response at low frequencies. The treble control has two positions in which the highs are boosted and three in which they are cut.

The compensation network has a high output impedance, so low-capacitance cable should be used between the tuner and the main amplifier. This cable should be kept short to avoid attenuation of highs and possible reduction in signal level. END



Schematic of the cathode-follower output-amplifier and tone-control circuit.

DUAL-CHANNEL REMOTE AMPLIFIE

Broadcasters and sound-recording technicians will find lots of use for this compact mike-control amplifier

By ROLAND JORDAN, JR.

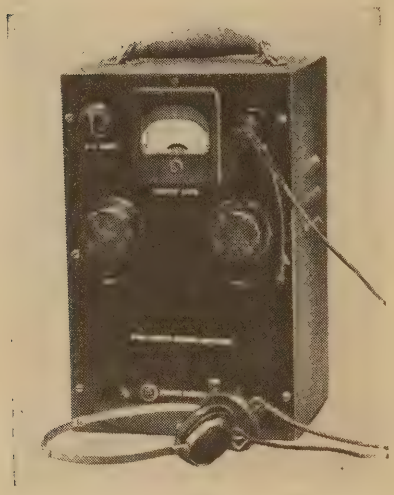


Fig. 1—The portable two-channel remote broadcast or recording amplifier.

SOONER or later, every broadcast station or recording studio finds its equipment is no longer adequate to meet the growing requirements of the business. By the time this point is reached, the station engineer knows all the shortcomings of his present equipment, and can plan new units which will overcome the faults of the old.

This time arrived at WSBB some months ago when it became necessary to leave our only remote amplifier at a permanent remote point 15 miles from the station. This left us with no remote unit for the weekly church broadcasts and other day-to-day needs. After thumbing through equipment catalogs, we decided that for maximum quality and utility at minimum cost, we would construct our own dual-channel remote amplifier. Fig. 1 shows the completed unit, which we believe justifies the effort and time expended.

Design requirements

The first step in a project such as this is, of course, to decide just what features you require. The next step is to figure out how to provide them at minimum cost. In this case we wanted two low-level mike inputs; means for mixing the two inputs with no interaction between them; negligible distortion and hum; and an output level of at least + 14 vu into a 600-ohm l
In addition we needed a vu meter, provision for monitoring the outp either with headphones or through external amplifier-speaker system. this had to be built into a light, pact, portable unit, and—as in broadcast equipment — without short cuts or compromises that m sacrifice dependability. The unit been in constant use for nine mo now, and we are convinced that design objectives were met very

Circuit details

Fig. 2 is the schematic of the a fier and power supply. We wanted pull output to cancel even harm (and, incidentally, because we happ to have a suitable output transfo on hand). In searching for a quality phase inverter to feed the put stage, we remembered the *coupled* amplifier-phase inverter.

This circuit was developed by Van Scoyoc, and was first report *Radio News* (Electronic Engine edition), for November 1948. At time it was incorporated in a PA plifier and proved entirely satisfac It has many advantages, the mos portant of which are ease of balan excellent low-frequency response to direct coupling, and the fact t requires only a few small resist

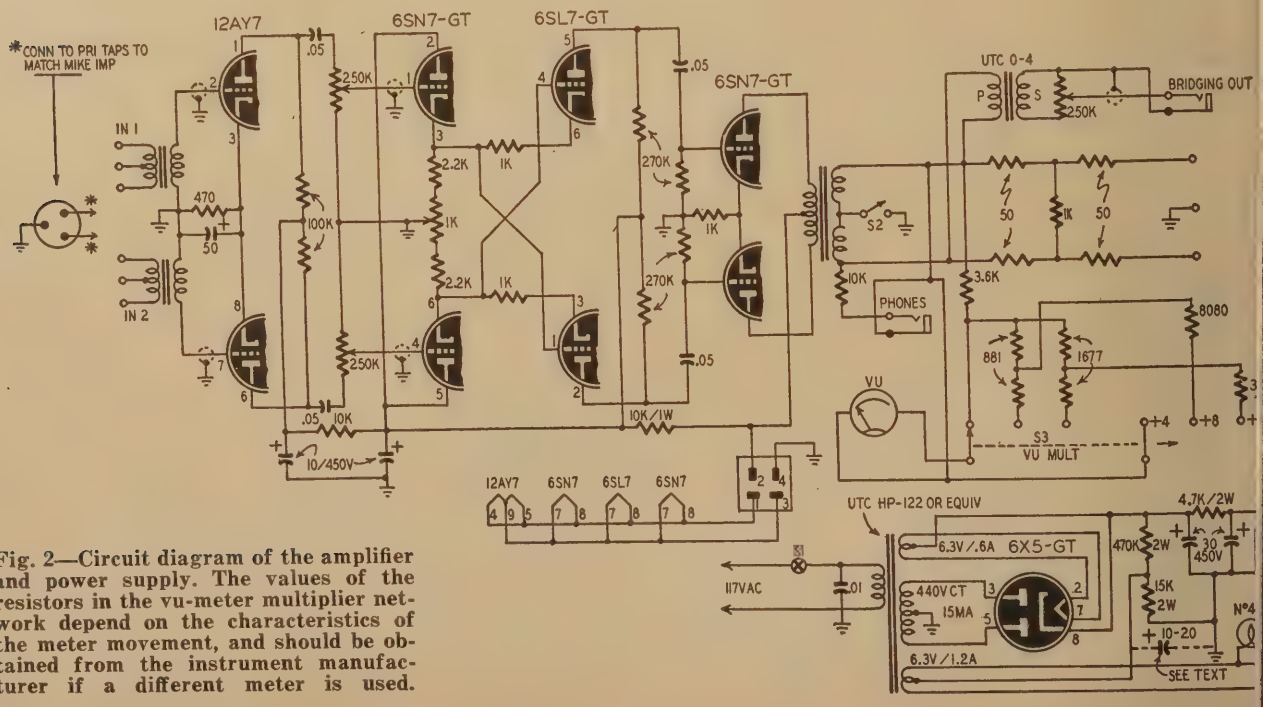


Fig. 2—Circuit diagram of the amplifier and power supply. The values of the resistors in the vu-meter multiplier network depend on the characteristics of the meter movement, and should be obtained from the instrument manufacturer if a different meter is used.

The two mike-input stages are the sections of a 12AY7 twin triode. is tube was developed especially for -noise, low-microphonic audio appli- ions and has very low susceptibility hum pickup.

n tracing our schematic from the mike inputs, the signals pass first ough the UTC type O-1 *Ouncer* in- transformers. The two halves of 12AY7 are separate except for the mon cathode connection. This saves ce and we can find no ill effects m it. Next come the gain controls. se are commercial step-type attenu- rs, but good-quality carbon controls ld probably be used.

Next comes the cross-coupled mixer- se-inverter circuit. The 1,000-ohm entiometer in the 6SN7-GT cathode uit is a screwdriver-type balancing trol. The plate-load resistors for the 7-GT should be matched as closely ossible. The output circuit is a con- tional push-pull stage with a 600- line transformer.

ll coupling capacitors are the ded type, for low leakage and long Top-grade resistors should be used ll circuits, especially in the plate uits of the input stages. The depos- -carbon-type, such as IRC *Precis-* have extremely low noise level. e-wound resistors are the best, but must be the *noninductive* type in e and grid circuits. A 10,000-ohm ging resistor is connected in series the headphone jack, and the 4-db between the output-transformer ndary and the line jack isolates the lifier from the line, to prevent ges in line impedance from affect- the load as this is seen by the out- tubes.

he vu meter is the most expensive ponent in the amplifier. This might n unnecessary refinement in some s, but it is essential in a broadcast te amplifier. It gives the remote ator a meter with the same char- istics as the one in the console which he is feeding, and simplifies the problem of riding gain. The V.U. MULT. switch S3 at the left of the meter in Fig. 1 inserts suitable 3,900-ohm T-pad multipliers between the vu meter and the output line. The values given in the schematic are for ranges of + 4 vu, + 8 vu and + 12 vu.

The power supply is on a separate chassis and uses plug-in filter capacitors along with a 4,700-ohm filter resistor. A choke would have been better here but we didn't have one small enough. The center-tap of the heater winding is returned to a point on the bleeder, which is a few volts positive. This helps reduce any hum caused by heater-to-cathode leakage in the low-level stages. Since the heater string is biased positive by this connection, the pilot-light socket must be insulated from ground. In some cases this center-tap connection may have to be bypassed direct to ground with a 10-μf or 20-μf capacitor.

The power transformer is a UTC HP-122, a special low-flux-density unit. A less expensive transformer can be used if the chassis is big enough to allow the transformer to be placed farther away from the input transformers.

Construction features

Fig. 3 shows how the separate power-supply and amplifier chassis are mounted on the front panel. A four-prong Jones plug and socket is used for power connections.

Toggle switch S2 on the rear apron of the amplifier chassis grounds the center-tap of the output-transformer secondary when feeding a balanced line. Mounting the input transformers with circular clamps allows them to be rotated on their horizontal axes and tilted vertically to eliminate hum pickup from the power transformer.

Fig. 4 and Fig. 5 are bottom views of the amplifier and power-supply chassis. The bottom view (Fig. 4) of the amplifier chassis shows the step-type attenuators and the balancing control directly between them. Microphone cable was used for the shielded input leads because of its low capacitance. All ground connections are made to a heavy bus. The bottom of the amplifier chassis is normally covered with a metal plate, cut out to clear the two gain controls. The unit was built in a steel cabinet 12 x 7 x 7¾ inches.

Auxiliary output

We sometimes have to feed a PA system from the remote amplifier, so a bridging output circuit with separate volume control was added after the photographs were taken. It consists of a UTC O-4 *Ouncer* interstage transformer with its primary connected across the secondary of the output transformer and a 250,000-ohm volume control across the secondary, which feeds the PA system.

The unit has been used for nine months and has served on almost every conceivable type of remote pickup. So far, it has given absolutely no trouble. While we have never had an opportunity to make frequency-response or distortion measurements on this amplifier, it's necessary only to hear it reproduce organ music from a church remote to know how good it is. END

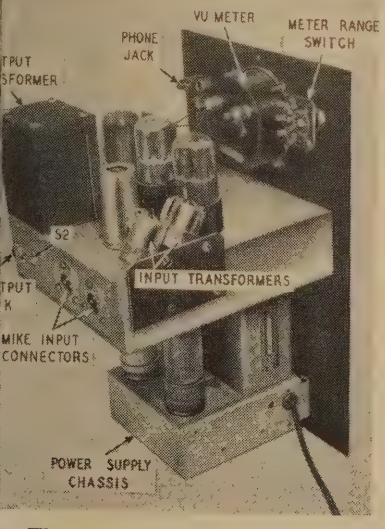
Materials for remote amplifier

Resistors: 1—470,000 ohms, 1—15,000 ohms, 1—4,700 ohms, 2 watts; 2—10,000 ohms, 1 watt; 4—270,000 ohms, 2—100,000 ohms, 1—10,000 ohms, 2—2,000 ohms, 4—1,000 ohms, 1—470 ohms, 4—50 ohms, ½ watt; 3—250,000-ohm potentiometers (see text); 1—1,000-ohm wire-wound potentiometer; range multipliers for vu meter (see text and schematic).

Capacitors: (Paper) 4—.05 μf, 1—.01 μf, 600 volts; (electrolytic) 2—30 μf, 2—10 μf, 450 volts; 1—50 μf, 50 volts.

Transformers: 2 low-level multiple line to grid (UTC type O-1 or equivalent); 1 low-level push-pull plates to 600-ohm balanced line (Audio Development Company type A-5824 or equivalent); 1—single-plate-to-single-grid interstage (UTC type O-4 or equivalent); 1 power transformer—440 volt c.t. at 15 ma; 6.3 volt c.t. at 0.6 amp; 6.3 volt c.t. at 1.2 amp (UTC type HP-122 or equivalent).

Miscellaneous: 1 vu meter; 1—12AY7, 2—6SN7-GT, 1—6SL7-GT, 1—6X5-GT; 1—9-pin miniature socket, 4 octal sockets; 1 two-circuit, three-position switch; 2 s.p.s.t. toggle switches; 2 single-circuit phone jacks; 2 broadcast-type three-circuit microphone connectors; 1—4-prong plug and socket; 1—No. 47 pilot lamp; 1 fully insulated pilot-lamp socket; 2 chassis; 1—12 x 7¾ x 7-inch steel cabinet; line cord and plug; terminals; wire; solder; hardware.



—The amplifier and power-supply is mounted on the cabinet panel.

Fig. 4—Underneath the amplifier chassis. Cylindrical units are gain controls.

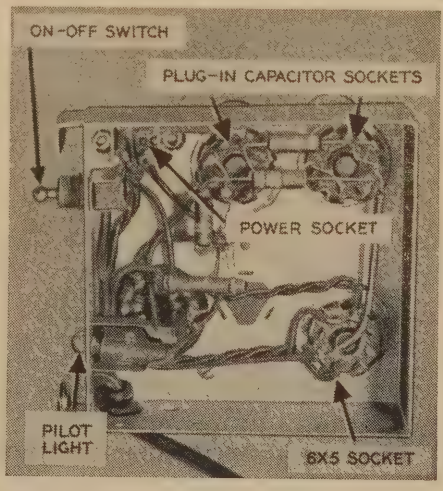


Fig. 5—Parts layout and wiring on the underside of the power-supply chassis.

PUSH - PULL DRIVERS

Part III—Two-tube "see-saw" phase-splitters meet high drive requirements

By GEORGE FLETCHER COOPER

IN THE first installment of this series on the problem of connecting a single-ended amplifier to a push-pull stage we examined the reasons which make it important to get good balance —to have equal *push* and *pull*—and we considered some common but unsatisfactory circuits.

We then went on, in the second installment, to look at a simple but very effective arrangement. The circuit described there—with its load split equally between plate and cathode—enables the pentode driver to give a gain practically equal to its amplification factor. Tubes such as the 6J7 or European EF37 make excellent drivers, because they have higher impedances than newer miniature pentodes such as the 6AK5, and stage gains of over 1,000 are referred to in the literature.

The disadvantage of this type of phase splitter is that the cathode is away above ground, at a steady potential of perhaps +100 volts, so if you use it to drive a pair of 6L6's, the cathode will swing up to +130 volts on positive half-cycles. The tube maker rather disapproves of this; if you can get him to quote a limit on heater-cathode potential difference it is usually about 90 volts maximum. My own solution to this problem is to return the heater center point to a +50-volt tap on the plate-supply bleeder, so that the phase-splitter cathode swings up to only +80 volts relative to the heater, while all other cathodes are at about −50 volts relative to their heaters. I do this in any case, because I find it reduces the hum caused by leakage current from heater to cathode flowing back to ground through the cathode-bias resistor. By saturating this leakage path with d.c., the 60-cycle leakage current becomes a minor fraction of the total, and the hum from the heater disappears.

A second very important push-pull driver is rapidly becoming popular. It is not a new circuit; it seems to be more than 20 years old, but it has come to the fore with the growing demand for quality at high signal levels and the introduction of good small double triodes. This circuit is known variously as *anode-follower*, *see-saw* or *paraphase*. The basic circuit is shown in Fig. 1. Each triode has its usual cathode-biasing resistor (not shown) and its standard plate-load resistor (R_{L1} and R_{L2}). R_{L1} is equal to R_{L2}, of course. The input is applied to the grid of tube 1. Two resistors, R_1 and R_2, are connected in series between the plates, and the grid of tube 2 is driven by the mid-point of these two resistors through the C-R_g coupling circuit. R_1 is slightly smaller than R_2, but both are very large compared with R_L, so that we can neglect their additional loading effect. Similarly we can forget C-R_G in our first discussion.

The see-saw circuit

This circuit is traditionally explained by drawing the see-saw of Fig. 2. Suppose the circuit is working as a perfect push-pull system balanced symmetrically at O, and P_1 swings down to X as P_2 swings up to Y, with $P_1X=P_2Y$. Divide the line P_1P_2 at A so that $P_1A/AP_2=R_1/R_2$. Draw AG parallel to P_1X (and P_2Y) to meet the line XY at G. Then AG—the voltage at A—is the grid drive to tube 2. It does not take much recollection of school geometry to see that $P_2Y/AG=P_2O/OA$ (Corresponding sides of similar triangles). Now P_2Y/AG is the gain of stage 2, which we can call m, and if we remember that O is the mid-point of P_1P_2 we see that $OP_1=OP_2=(P_1P_2)/2=(R_1+R_2)/2$. $OA=OP_1-AP_1=(R_1+R_2)/2-R_1$.

Therefore $m=(R_1+R_2)/(R_2-R_1)$, a result which can be twisted round to give $R_1/R_2=(m-1)/(m+1)$.

That last paragraph, which you may have skipped, is very easy to follow if you take a really big sheet of graph paper and draw the figure yourself. Make P_1P_2 equal 10 inches, and put A one-eighth inch to the left of the center-point O. This corresponds to a stage gain of 40, which is a bit high. With a scale drawing you will see how the line XY pivots about O, which means it pivots almost about the grid of tube 2, just like the plank of a see-saw, or "teeter-board".

Now suppose that for some reason tube 2 gives an unbalanced output, say PY^1. Joining XY^1 and prolonging the line AG, we get the new grid drive AG^1. On your big diagram you will see that for a small movement in Y you get a very large increase in grid drive, so that a very large change of gain does not unbalance the circuit much. This is merely clearing away the standard explanation, but before we go on we might just look at our one use-

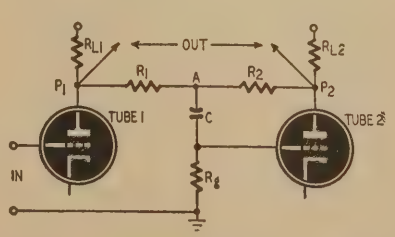


Fig. 1—*See-saw* phase-inverter circuit.

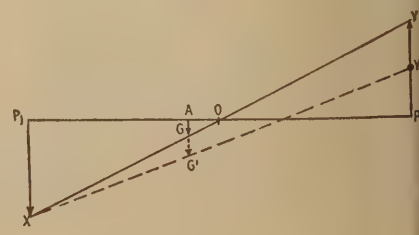


Fig. 2—Operating diagram of voltage relationships in *See-saw* phase inverter.

ful formula, $R_1R_2 = (m-1)/(m+1)$. We know that m will be about 40 for a 12AT7, so R_1/R_2 is about 0.95. If you are using ordinary commercial-tolerance resistors for R_1 and R_2, all you need do is pick the larger of a nominally equal pair for R_2 and use the other for R_1.

A more advanced explanation

I have never liked this way of explaining the circuit, because it does not lend itself to more detailed study. In this article we shall consider the circuit in a more formal way, regarding the second tube as a separate phase-reversing amplifier. To show this nicely, the circuit is redrawn in Fig. 3-a, and the second tube circuit is turned the usual way up in Fig. 3-b. Tube 2 has a feedback connection from plate to grid through R_2. We will forget about C and R_G, and will make R_1 and R_2 very much larger than R_{L2}, to keep the mathematics simple. First, it is obvious that $V_1/V_2 = m$, the gain of the tube itself, and m is given by the well-known formulas: $m(\text{triode}) = \mu R_{L2}/(R_p + R_{L2})$ and $m(\text{pentode}) = gmR_{L2}$. Also, as you know, if the grid goes negative the plate voltage rises, so if we drive the grid *down* 1 volt, the plate voltage *rises*, and across R_2 we get $(m+1)$ volts. The current through R_2 produced by a 1-volt signal at V_2 is therefore $(1+m)/R_2$, and to a man who has connected a voltmeter at A and an ammeter in series with R_2 it seems as though the resistance must be $R_2/(1+m)$.

You may have met this expression before, in another connection. Suppose that R_2 is replaced by a capacitor C_2, with a reactance of $1/\omega C_2$ ($\omega = 2\pi f$). The man with a meter will see a reactance of $1/\omega C_2(1+m)$ and will think there is a capacitor of $(1+m)C_2$. This is our old friend, the Miller effect, a curse to all high-frequency designers and the bread and butter of the designers of time bases.

For a voltage V_2 at A, the current flowing through R_2 must be $(1+m)V_2/R_2$, remembering that R_G is to be neglected. This current is produced ultimately, of course, by the applied signal V_o, so it must also flow through R_1. The voltage across R_1 is $(V_o - V_2)$, and we must have the same current flowing through R_1 and R_2. $(V_o - V_2)/R_1 = (1+m)V_2/R_2$. Rearranging, we get

$$\frac{R_2}{R_1} = \frac{m+1}{m\,(V_o/V_1) - 1}$$

Since we want $V_o = V_1$, a unity ratio phase-reverser, we must have $R_2/R_1 = (m+1)/(m-1)$, the result we obtained before by the simple geometrical method. We can now study more closely what happens if m changes, through tube aging or for any other reason, including the tolerances in R_{L2}. We have $V_o/V_1 = \frac{1}{m}\left[1 + (1+m)R_1/R_2\right]$, which is normally 1. Let us start with $m = 40$, so that $(m+1)/(m-1) = 41/39$ and, $R_1/R_2 = 39/41$; $V_o/V_1 = 1$. Now let m drop to 30, and we have $(V_o/V_1) =$

$$V_o/V_1 = 1/30\,[1 + 31(39/41)\,]$$
$$= 30.48/30$$
$$= 1.016$$

This change in tube gain has thus produced an unbalance of 1.6%, while in the circuits of Part I, a gain change of this order would have caused an unbalance of 33%. There is, you see, a considerable improvement.

A noncritical circuit

What I like most about this circuit is its simplicity: it does not seem to use any more components that the circuit I dislike so much. The cathodes are grounded, except for the ordinary self-bias drop, so there is no problem of heater-cathode voltage. The plate loads need not be matched carefully, because the feedback takes care of normal differences, though you should make them nominally equal since both tubes need to develop the same output. The splitting resistors R_1 and R_2 are the only critical components, and a quick check with an ohmmeter is enough to select a pair in which R_2 is about 5% higher than R_1: the actual value is not critical. And since we have full feedback around tube 2, there is no extra distortion here.

Before we look at some variations on this simple theme, we must consider what stray capacitance does to unbalance the circuit at high frequencies, and what our neglected components C and R_G do, especially at low frequencies. This is where we reap the benefit of our more formal approach: I just cannot see how strays can be fitted into the geometrical treatment.

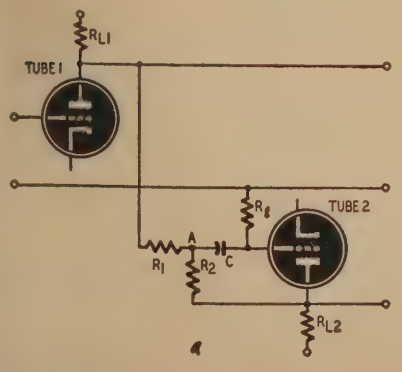
First we see that any strays across tube 1 have no effect on the balance at all, because they affect the response before we go into the circuit of tube 2, and if the response drops there is less drive to tube 2. The strays across tube 2 are the main problem, because the *push* signal from tube 1 is not affected by them. Now any capacitance to ground at the plate of tube 2 is in parallel with R_{L2} and will pull down the stage gain at high frequencies; but—as we have just seen—the effect of changes in stage gain is very small indeed. So we are not too worried by these strays.

At low frequencies the blocking capacitor C begins to have some effect. Between point A (Fig. 3-b) and the tube grid there will be a 3-db drop at the frequency where $2\pi fC = R_g$. But all our calculations so far have been referred back to point A, so that this 3-db drop is included among changes in m, and we have just seen that a 25% drop in m produces an unbalance of only 1.6%. If we intend to work down as low as 30 cycles, we can take $C = 0.01\mu f$ and $R_g = 500{,}000$ ohms, and have only this 1.6% unbalance. In a very complex feedback amplifier we might need a larger capacitor, because at frequencies of a few cycles we should get a small *increase* of phase shift owing to the feedback. I think this effect is almost always unimportant.

A numerical example

This circuit is balanced and stays balanced in spite of strays, blocking capacitors, and tube variations. Let us now put in some numbers. A 12AT7 operating at 6 ma with a bias of −1.5 volts has a μ of 50 and a plate resistance (R_p) of 12,000 ohms. The voltage at the plate will be about 160, and the maximum swing perhaps 60 volts peak, or 42 volts r.m.s. Using 48,000 ohms for plate-load resistors R_{L1} and R_{L2}, the gain m is exactly 40, and a standard resistance value—47,000 ohms—fits perfectly. The total supply voltage must then be $160 + (47{,}000 \times .006)$, or 442 volts, which is quite a practical value if you are using output tubes which take 40 volts drive. The cathode resistors are nominally 250 ohms (270 is a preferred value). For smaller drives I still use 47,000 ohms in the plate, but drop the supply voltage and increase the cathode resistance.

We must now choose R_1 and R_2, which are to be much bigger than R_{L1} and R_{L2}.



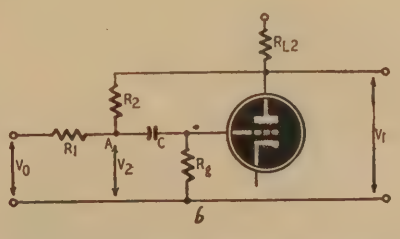


Fig. 3—(a) *See-saw* circuit redrawn to show phase-inverting action of tube 2. (b) Input- and output-voltage relationships in the phase-inverting stage discussed in the accompanying text.

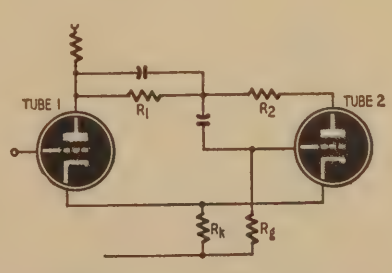


Fig. 4—If a common cathode resistor is used in the *see-saw* circuit, stray capacitance across R1 converts the inverter into a cathode-coupled multivibrator.

A suitable value is 470,000 ohms, but we run into trouble at once, because we want R_g to be much bigger than this, and the tube maker tells us not to make R_g more than 470,000 ohms. Things are not too bad, however. We saw that the apparent impedance at A in Fig. 3-b due to R_2 is $R_2/(1+m)$, or 470,000/41. Connecting R_g in parallel with this produces only a 2½% error, and we make up for this by making R_2 about 5% larger than R_1.

When we lightly wrote down the cathode resistance as 270 ohms in the last paragraph we did not stop to consider the local feedback effects. As the two tubes are in phase opposition, there will be no audio current in the cathode circuit if the two cathodes are connected together, and we could use a 135-ohm common bias resistor. But suppose there is a small stray capacitance across R_1; we shall have the circuit shown in Fig. 4, which you will recognize as a multivibrator. This may oscillate at high frequencies, though I have never encountered the effect in practice. A small bypass capacitor—say 0.01 - 0.1μf—across the cathode resistor will cure this trouble, if you should meet it. It is worth while avoiding the local feedback, because it costs about 6 db in the gain of tube 1, which must be paid for in reduced feedback around the complete amplifier. It also reduces the initial balance of the phase-reversing stage, although with local feedback m will not change much and the effect of tube variations is the same with and without local feedback.

It is sometimes stated that a small capacitance should be connected across R_1. The object is to balance the plate-grid capacitance of tube 2, which is in parallel with R_2, and which causes an increase in the feedback around tube 2 at high frequencies. The plate-grid capacitance of a 12AT7 is 1.45 μμf, so with socket and wiring it should not total more than 10 μμf. The effect will be important at about 30 kc where $\frac{1}{2\pi fc} = 470{,}000$. Where is the program with enough audio power to make the 30 kc balance important, and where do you get ears to hear it with? This extra capacitor is, as we have just seen, at a danger spot anyway, and I think is best omitted.

Some similar circuits

Three variants of this circuit are worth noting. The first is shown in Fig. 5, and it appears quite attractive until you look at it more closely. It saves one capacitor and one resistor, because the grid drive is picked off after the usual plate-coupling capacitors to the next stage. The theoretical results are practically identical, and the balance is only a fraction of 1% different from the values obtained in our earlier discussion. The objection to this circuit is purely practical; we are using it to drive fairly large tubes. We cannot, of course, use fixed bias on these, because the bias would also be applied to the grid of tube 2. On signal peaks we shall get some grid current; indeed we shall probably always have a little grid current in the output tubes. It does not matter if the 25-40 volt bias on the output tubes is supplemented by 1-2 volts of bias due to grid current, especially as any bias pulses will be in push-push. But two volts of bias on tube 2 will shift its working point until it can no longer deliver its full output. Any attempt to avoid this involves using such low grid resistances that gain is lost in the driver stage.

The second variant is shown in Fig. 6. I really cannot discover very much value in this, although in theory it gives a slightly better balance at low frequencies, at the cost of two capacitors instead of one. If a really good balance is needed at very low frequencies, a bigger blocking capacitor can be used in the basic circuit.

The third variant is shown in Fig. 7. This uses the fewest components of all, but as you can see, all the grid current for tube 2 and for the power tubes passes through R_g. If R_g is made small to avoid bias trouble, it has a loading effect which complicates the choice of R_1 and R_2. Theoretically it would be possible to use a large inductance in place of R_g, but who wants to use hundreds of henries to save a .01-μf capacitor?

Which circuit is best?

The anode-follower circuit is superior to the split-load circuit described last month in output capacity. The first tube delivers no power to the second, so that the drive available for each half of the output stage is the full output from one tube; the split-load circuit gives only half a tube output to each side of the final stage. Using triodes there is no difference in gain, but the impedance increase trick with the split-load circuit allows you to get a much larger gain if pentodes are used. In both circuits the tube in which phase reversal takes place has so much feedback that distortion can be neglected. From the point of view of supply noise the anode follower is probably slightly better, but at those levels the question is not usually important. Both circuits have the disadvantage that the impedances at the two push-pull output points are not the same. This effect is a little worse with the split-load type than with the anode follower.

When class-B output stages are to be driven up into grid current it is worth while adding an extra feedback path, which in the case of the anode follower should run from the plate of tube 1, while in the split-load circuit it should run from the plate of the splitter tube. This feedback is taken to a point earlier in the amplifier and is adjusted to give the correct impedance to match the other side of the phase-splitting system. In the example we have considered in this article, the feedback should reduce the gain 26 db. An extra tube will be needed to make up the loss due to this internal feedback loop, but the response up to the grids of the final stage should be very flat and free from phase shift over a very wide band. As a result, the feedback loop of the complete amplifier will be affected mainly by the characteristics of the output transformer, and this may help in simplifying the design of this large and awkward element. Unequal drive impedances will cause behavior differences on "push" and "pull".

As we have seen, this circuit uses negative feedback to force the two *output voltages* into equality. The next and final article will be concerned with a circuit in which feedback is used to force the *load currents* into equality. With equal loads—to a first approximation—equal currents give equal output voltages. The new circuit is especially valuable for feeding accurately balanced deflecting voltages to cathode-ray oscilloscopes. END

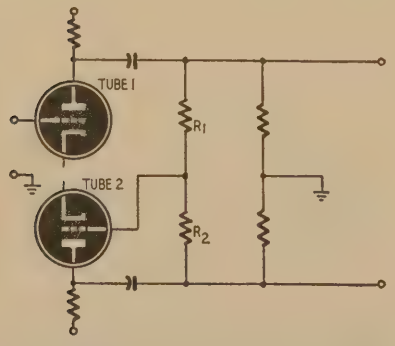


Fig. 5—This circuit variation saves a coupling capacitor, but has drawbacks.

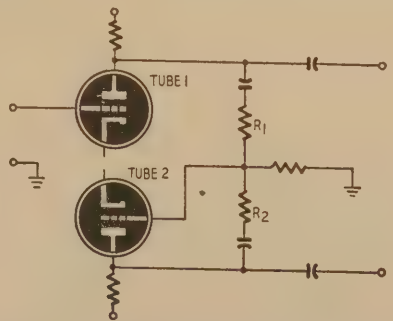


Fig. 6—Modified *see-saw* inverter circuit for better balance between driver output voltages at low frequencies.

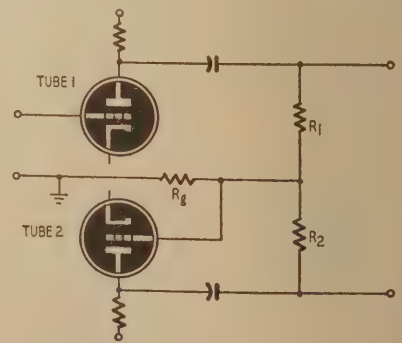
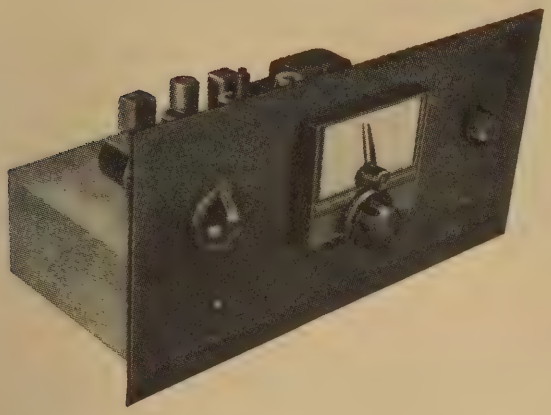


Fig. 7—Ultra-simplified form of *see-saw* phase inverter. Output-tube grid current may overbias tube 2 unless R_g has low value or is replaced by an expensive, high-inductance audio choke.



This tuner fits standard cabinets or mounts conveniently in a bookshelf

HIGH-QUALITY AM TUNER

Resistance-loaded i.f.'s pass full audio bandwidth for local hi-fi reception

By JOHN POTTER SHIELDS

THIS tuner was designed and built to provide a compact but high-quality unit to tie in with an existing high-fidelity audio installation. This tuner has the advantages of relatively small size and ease of construction; and it will provide an audio signal of high quality. It can be easily connected to the audio circuit of a TV set or to any audio amplifier.

The circuit is shown in Fig. 1. It is essentially a standard superhet, but several changes have been incorporated in the circuit to give superior performance. One of the main reasons why superhet circuitry has not been too popular in hi-fi work is the relatively narrow pass-band of the i.f.-amplifier stage or stages. There are several ways of overcoming this. One is to use over-coupled tuned circuits in the i.f. stages; another is to add "swamping" resistors across the i.f. tuned circuits to lower their effective Q and broaden the response. The latter method is the one used in this tuner. Although "swamping" decreases the stage gain, the loss is more than offset by the improved audio response resulting from the increased bandwidth.

Circuit details

An infinite-impedance detector was chosen in preference to the conventional diode for several reasons. First of all, due to its nonlinearity at low applied voltages the diode detector requires a relatively large r.f.-input signal for undistorted audio output. Since the gain of the tuner is lowered by the resistors across the i.f. tuned circuits, it was felt that some of the weaker stations might not develop enough signal voltage to a diode detector to give an audio output of reasonably low distortion. Besides, in the infinite-impedance detector the load resistance is between cathode and ground, providing 100% degenerative feedback at the audio frequencies.

A separate a.v.c. rectfier is required, since a.v.c. voltage cannot be obtained from an infinite-impedance detector. The circuit is similar to one published in the *Sylvania* booklet, "40 Uses for Germanium Diodes." A 1N34 crystal diode is connected from the secondary of the last i.f. transformer to ground through a .002-μf capacitor. Resistor R1 and capacitor C1 filter out the r.f. and a.f. components from the rectified voltage, which is then fed to the i.f.-amplifier- and mixer-tube control grids. A 6E5 electron-ray tube is connected to the a.v.c. bus as the tuning indicator.

One of the new *Ferri-loopsticks* is used in place of a conventional loop antenna. The *Loopstick* is an extremely high-Q permeability-tuned inductance which has the advantages of being small in size, and easy to mount. It has provisions for connecting an external antenna to increase the sensitivity. The *ferrite* slug supplied with the unit, is slid in or out of the coil until the position of maximum volume is found. This adjustment is quite critical. A conventional antenna coil or loop antenna can be used in place of the *Loopstick*. If a loop is used, keep it well separated from the chassis or other metallic objects to prevent lowering the Q of the loop, and reducing the sensitivity.

A transformer-operated power supply was chosen to isolate the chassis from the line, and for the better filtering obtainable with full-wave rectifica-

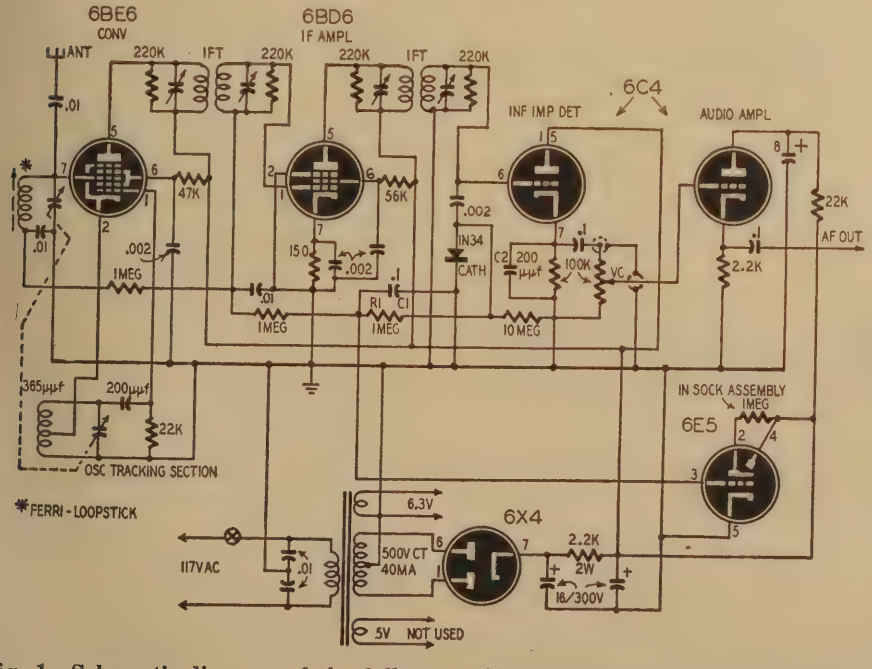
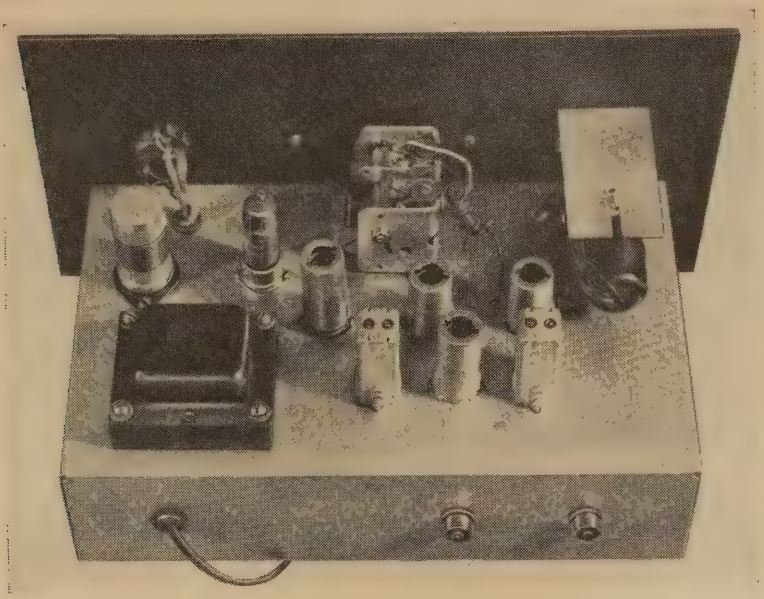
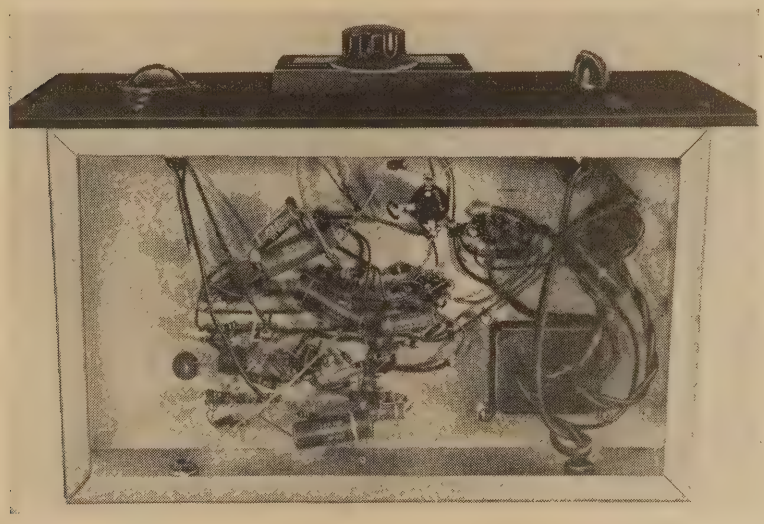


Fig. 1—Schematic diagram of the full-range AM tuner for the broadcast band.



Placement of principal components on the top of the high-quality tuner chassis.



Parts layout under the chassis. Note use of molded capacitors and direct wiring.

tion. A heater-cathode-type rectifier tube is used so that plate voltage will not be applied to the receiving tubes until they are heated sufficiently to draw plate current.

A cathode-follower audio stage is incorporated in the tuner after the infinite-impedance detector. While separate 6C4's are shown in the schematic, one for detector and one for the audio amplifier, a single twin-triode such as a 12AU7 or 12AY7 can be used as well. (The writer happened to have two 6C4's and no 12AY7's at the time the tuner was built.) The cathode follower

Materials for tuner

Resistors: 1—2,200 ohms, 1 watt; 1—10 megohms, 3—1 megohm, 4—220,000 ohms, 1—100,000 ohms, 1—56,000 ohms, 1—47,000 ohms, 2—22,000 ohms, 1—2,200 ohms, 1—150 ohms, ½ watt; 1—100,000-ohm potentiometer (audio taper).
Capacitors: (Electrolytic) 2—16 μf, 1—8 μf, 300 volts. (Paper) 4—0.1 μf, 4—.01 μf, 400 volts. (Ceramic or mica) 4—.002 μf; 2—200 μμf. (Variable) 1—two-gang broadcast tuning capacitor, r.f. section 365 μμf maximum, with cut-plate oscillator tracking section.
Transformers: Power transformer—500 volts c.t., at 40 ma, 6.3 volts at 2 amp, 5 volts at 2 amp (Thordarson 22R00 or equivalent); 2—455-kc i.f. transformers (Meissner 16-6678 or equivalent); 1—broadcast-type tapped oscillator coil (Meissner type 14-1053 or equivalent); 1 *Ferri-Loopstick*.
Miscellaneous: 1—6BE6, 1—6BD6, 1—6E5, 1—6X4, 2—6C4 tubes; 5—7-pin miniature sockets; 1 Amphenol 6E5 socket assembly; 1 s.p.s.t. switch (on volume control); chassis; dial; knobs; panel; line cord and plug; terminals; wire; solder; hardware.

minimizes high-frequency attenuation in this stage and allows the output lead to be almost any length.

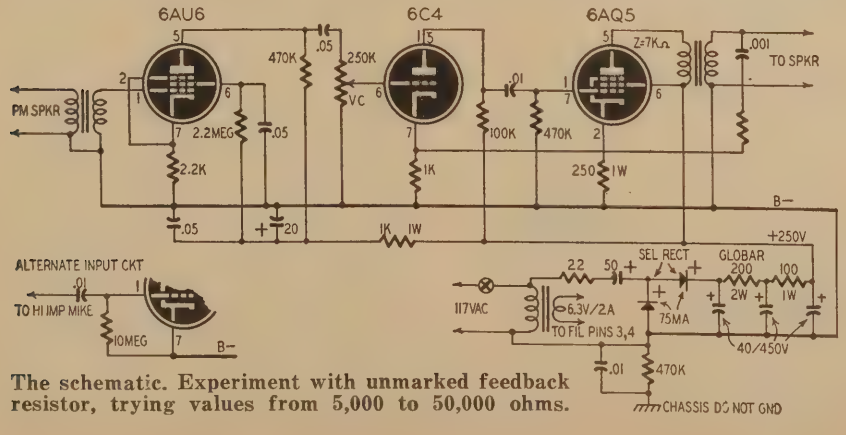
As mentioned earlier, the slug in the *Loopstick* is quite critical in adjustment. Adjust it for maximum volume in the middle of the tuning range, and it will give good reception over the entire band. For best results, add an external antenna about two feet long.

The swamping resistors shown in the schematic will provide a signal of excellent quality with some sacrifice in selectivity and sensitivity. If the tuner is to be used in rural areas or if you want better selectivity these can be increased in value or omitted. END

A MULTI-PURPOSE AUDIO AMPLIFIER

The diagram shows an inexpensive audio amplifier which can be used as a low-powered PA or paging system, phono amplifier, or baby sitter's amplifier. By adding a d.p.d.t. switch, you can convert it into a two-station intercom. The main schematic shows the input circuit which is used with a PM speaker as a microphone. The insert shows the input circuit modified for a high-impedance microphone or phonograph pickup.

A plate supply of approximately 250 volts is developed by a half-wave voltage doubler connected across the 117-volt a.c. line. The tube heaters are connected in parallel across the secondary of the 6.3-volt, 2-ampere filament transformer. (A half-wave type power transformer having a 115-120-volt secondary rated at 60 ma or more and a 6.3-volt, 2-ampere filament winding may be substituted so the unit can be completely isolated from the power line.)



The schematic. Experiment with unmarked feedback resistor, trying values from 5,000 to 50,000 ohms.

The Globar type F resistor in the B supply has a resistance of 1,400 ohms when cold and 200 ohms when hot. It helps to keep the B voltage from soaring before the tubes reach operating temperature. It also serves to limit the charging current drawn by the second and third 40-μf filter capacitors when the unit is first turned on. In addition, it acts as a fuse to protect the two selenium rectifiers in the event of a short circuit in the output filter or the amplifier.—*Wilbur J. Hantz*

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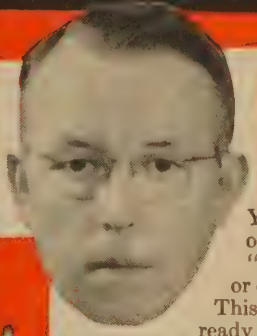
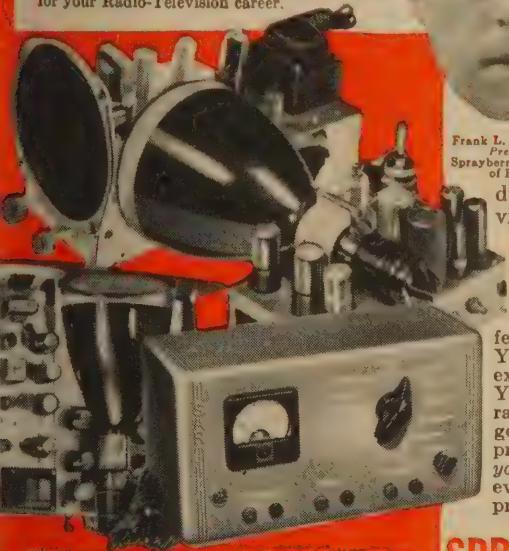


Frank L. Sprayberry
President
Sprayberry Academy of Radio



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ELECTRICITY FROM ATOMS

By H. W. SECOR

Electron emission from heaterless cathodes of radioactive phosphorus

DR. ERNEST G. LINDER, research physicist with the Radio Corporation of America, has taken out a patent (No. 2,598,925) for the direct production of electric current from atomic sources.

In its simplest form, the Linder atomic generator consists of an evacuated metal chamber, in Fig. 1, in which is mounted a radioactive substance *R*, such as polonium. Electrons from the radioactive substance strike the metal shell *S* and build up an electric charge on it. If a load *L* is connected between the radioactive cathode and the metallic shell anode, current will pass through it and do useful work.

The emitter, or cathode, of this generator may be either positive or negative, depending on the radioactive element. If it is polonium, it will radiate alpha particles, and the collecting

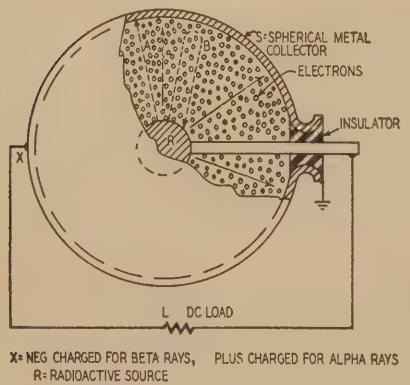

Fig. 1—Linder atomic d.c. generator.

shell will be charged *positively*. If radioactive phosphorus is used, beta particles (electrons) are radiated, and the charge on the metal shell is *negative*.

As much as two kilowatts of energy may be produced by such an atomic-electric generator. This value is based on the assumption that 1 gram of radioactive phosphorus, occupying but ½ cubic centimeter, will emit about two milliamperes of electric current. If the average energy of emission is 1,000,000 volts, the electric energy amounts to .002 amp × 1 megavolt, or 2,000 watts (2 kw).

Radioactive phosphorus has a half-life period of about 14 days, so the current and power would decrease exponentially to one-half their initial values in that time. Possibly in the near future some simple means will be devised for replenishing the radioactive material in the electric generators periodically.

Radioactive phosphorus is a pure beta-ray emitter, which becomes stable after emission. This material is suitable for use as electronic power sources, since it emits no gaseous reaction products and therefore is quite suitable for vacuum applications, Dr. Linder states.

In practice it will be possible to modify the atomic-electric generator units or connect them in series or parallel (or series-parallel) groups so that the desired voltage and current values can be obtained. With the a.c. generator the voltage can easily be reduced by a transformer.

The impedance of the atomic electric generator is determined by the characteristics of the charged particle emitting substance. A d.c. generator of the type described is suitable for systems requiring high voltage and low power capacity. If large-power generators are to be built, the charged particle element may be cooled by circulating water or a forced air draft.

An a.c. generator

Fig. 2 discloses that the a.c. unit is similar to the d.c. generator. One distinct advantage of the a.c. generator is that it is particularly well suited to the generation of radio-frequency energy; the collector electrode *S* may be dimensioned to *resonate* at the desired frequency. If the radioactive source *R* emits negatively charged beta particles, these will charge the tuned electrode *S* to a high negative potential, as indicated by dotted arrow *A*. (An insulated rod supports the radioactive source element *R* as shown.)

After the electrode *S* attains the

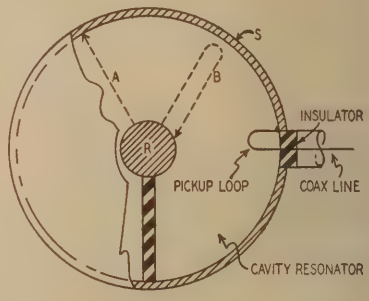

Fig. 2—Generator for high frequencies.

maximum potential of the beta particles, additional particles are reflected back toward the source *R*, as arrow *B* indicates. As the collector electrode is resonated at the desired radio frequency, the reflected electrons oscillate back and forth between the source *R* and the electrode *S*, setting up an oscillating electric field within the resonant collector.

To abstract r.f. energy from this oscillating field, a pickup loop may be used as shown in Fig. 2. A coaxial cable *C* may conduct the r.f. current to the load. The operation is similar to that of the reflex velocity-modulated oscillator, or to the older Barkhausen-Kurz oscillator.

In a recent interview Dr. Linder stated that he could not discuss his atomic-electric generators in detail, nor disclose for what purpose they are to be used, as this matter is bound up in military security. This general outline is presented here, however, because of the unique operating principles of these newest types of electric generators. END

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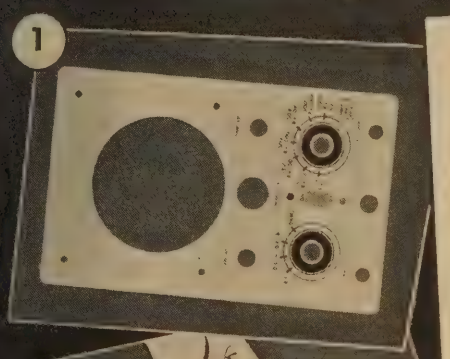

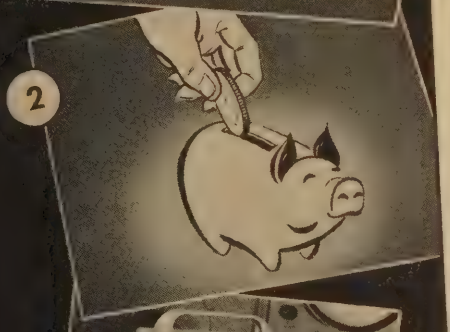

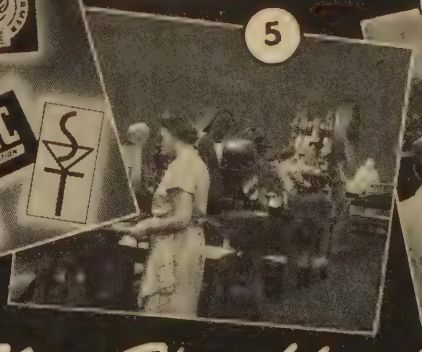

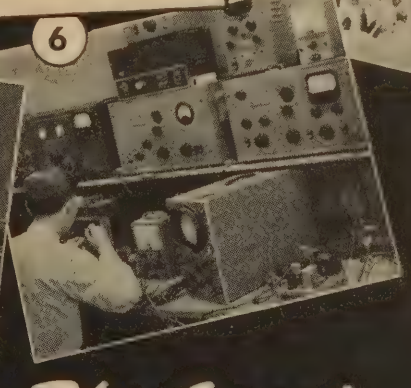

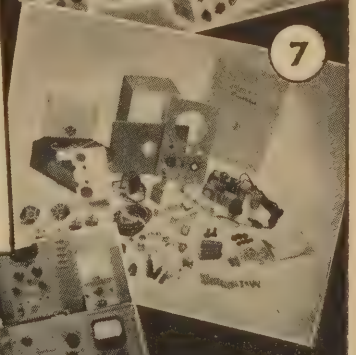

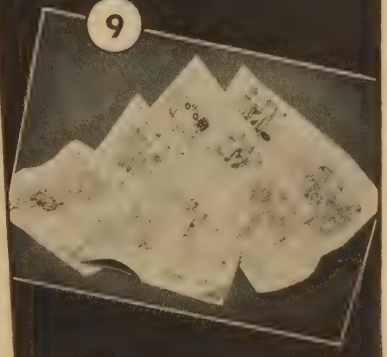

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NEW *Heathkit* "Q" METER KIT

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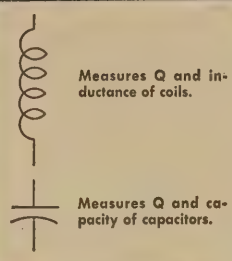
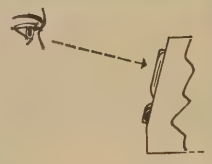
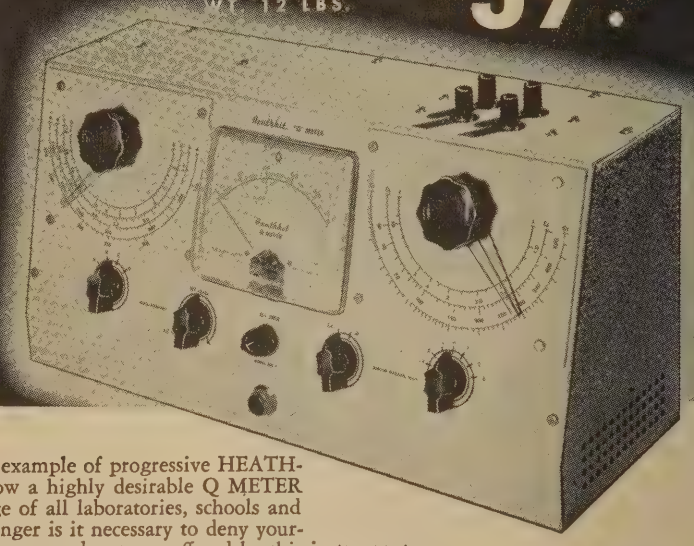


Measures Q and inductance of coils.

Measures Q and capacity of capacitors.



Slant face cabinet for ease in reading the meter.



- First Q METER within the price range of all.
- Read Q's of 0-500 directly on calibrated scale.
- Stable oscillator supplies R.F. frequencies of 150 kc to 18 megacycles.
- Calibrated capacitor with range of 40 mmf to 450 mmf with vernier of ±3 mmf.
- Simple, easy operation.
- Can be used to measure small inductances or capacitors.
- Measures Q of condensers, RF resistance and distributed capacity of coils.
- Measures capacity by substitution, capacity by resonance, inductance by resonance.
- Slanted panel for convenient operation.

Another outstanding example of progressive HEATHKIT engineering. Now a highly desirable Q METER within the price range of all laboratories, schools and experimenters. No longer is it necessary to deny yourself the many measurement advantages offered by this instrument.

Use the new HEATHKIT Q METER for the following simple basic measurements: capacity by substitution, capacity by resonance, inductance by resonance and Q at the OPERATING frequency all can be read on the calibrated scales. The method used to obtain information regarding the Q of condensers, RF resistance, distributed capacity in coils, etc., is only slightly more involved. In the HEATHKIT Q METER, the generated RF signal is coupled through a cathode follower and injected across a low impedance condenser which is included in the resonant circuit under test. Large 4½" 50 microampere Simpson meter reads Q directly. The resonating condenser and vernier condenser are calibrated in mmf for substitution method capacity tests. The resonating condenser is also calibrated in effective capacity for resonance tests. The inductance calibration serves for rapid determination of the approximate inductance of a coil. The HEATHKIT Q METER has a generator frequency range of 150 kc to 18 megacycles. Vernier capacity covers ± 3 mmf and the resonating condenser is calibrated from 40 mmf to 450 mmf actual capacity or 40 mmf to 350 mmf effective capacity. Meter reads Q directly up to 250. Higher and lower full scale readings can be obtained by varying the injection voltage levels.

The entire kit consists of 12AT7, 6AL5, 6C4, OD3 and 6X5 tubes, 50 microampere Simpson meter, power transformer, cabinet and all other parts necessary for construction as well as instructions for assembling, testing and operation of the completed instrument.

Heathkit DECADE RESISTANCE KIT

The HEATHKIT DECADE RESISTANCE KIT is widely used by schools, experimenters and laboratories because of the extremely wide resistance range offered and the useful, dependable service provided. The DECADE consists of 5 rotary 2 deck ceramic wafer switches with silver plated contacts and twenty 1% precision resistors in a circuit which provides the resistance range of 1 ohm to 99,999 ohms in 1 ohm steps. The HEATHKIT DECADE RESISTANCE KIT is simple to construct and is housed in a beautiful polished birch cabinet with an attractive panel. The DECADE will furnish years of accurate trouble-free service.

Individual decade sections of above can be purchased separately for special applications.

MODEL DR-1
SHIPPING WT. 4 LBS.
$19.50

NEW *Heathkit* DECADE CONDENSER KIT

Extremely useful in all experimental and design work such as determination of condenser values for: compensating networks, filters, bridge impedances, tuned circuits, etc. *Uses all precision silver mica condensers within ±1% accuracy.* Values run in three decades from 100 MMFD to 0.111 MFD in steps of 100 MMFD. Smooth acting, positive detent, highest quality ceramic wafer switches make all capacitor values easy to set up and keep losses to a minimum. Low loss dielectric terminal board mounts on outside of panel for easy cleaning. Heathkit binding posts accommodate a wide variety of test leads. Comes complete with all parts, including polished birch cabinet.

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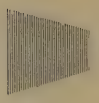
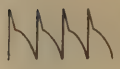
NEW *Heathkit* OSCILLOSCOPE KIT

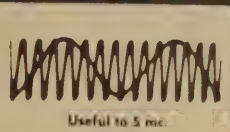
• NEW WIDE BAND VERTICAL AMPLIFIER ± 2 DB 10 CYCLES TO 1 MC.



Direct plate connections for modulation tests.



Displays TV sync pulses correctly.



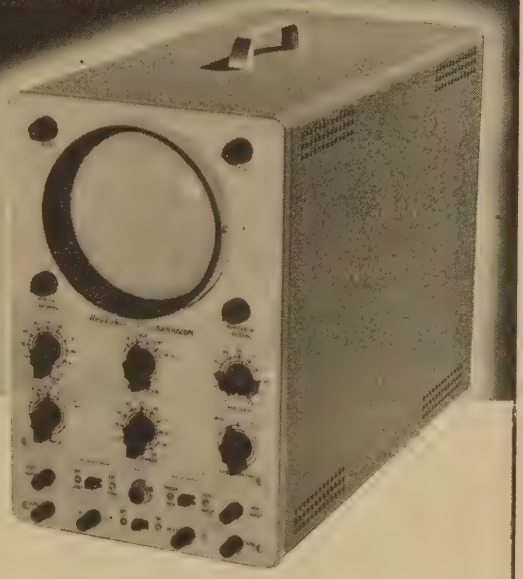
Useful to 5 mc.

Good square wave response at 100 kc.

MODEL O-8

SHIPPING WT. 29 LBS.

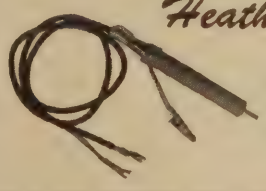
$43.50



- New wider band vertical amplifier ± 2 db from 10 cycles to 1 megacycle useful to over 5 megacycles.
- High sensitivity in vertical amplifier. .025 volts RMS per inch deflection.
- New 3 step input attenuator input ranges X1, X10, X100.
- New 5CP1 intensifier type tube for greater brilliance.
- Terminal board and rear cabinet opening provisions for direct connections to deflecting plates.
- Newly styled formed and ventilated aluminum cabinet.
- Wide band sweep generator, 15 cycles to over 100 kc. Will synchronize with 5 megacycle signal.
- 10 tube circuit featuring push pull operation of vertical and horizontal amplifiers.
- Internal synchronization on either positive or negative peaks.
- Reproduces faithfully the front and back porches of TV sync pulses. Excellent square wave reproduction to over 100 kc.
- Optional Intensifier kit available for 2200 volt operation.

Proudly announcing the new 1953 HEATHKIT Model O-8 OSCILLOSCOPE featuring the finest performance ever offered in this extremely popular kit instrument. Improved wider band vertical amplifier featuring a new 3-step input attenuator affording smooth control of the excellent .025 volts per inch vertical sensitivity. Possibility of overloading the vertical input circuit is minimized. Greater band width in the vertical channel is a decided advantage to TV service men. Permits clear observation of all TV sync pulse detail and excellent square wave reproduction over 100 kc. 5CP1 intensifier type CR tube provides a brilliant trace with normal accelerating voltages. A handsome, ventilated cabinet with smooth rounded corners and a snug fitting drawn panel adds to the smartly styled professional appearance. Longer life is assured through cooler instrument operation. Push pull output stages in both vertical and horizontal amplifiers for balanced deflection of the spot. All of the many fine features of the previous model have been retained. Rear cabinet access to terminal board for direct connection to CR plates. The entire kit of all 10 tubes, parts, cabinet and panel as well as detailed construction manual for assembly and operation of the instrument included.

INTENSIFIER KIT: For extreme trace brilliance in special applications such as photography, group demonstrations or operation in brightly lighted areas an optional Intensifier kit providing 2200 volt operation of the CR tube is available. Kit includes high voltage filter condenser, high voltage selenium rectifier, etc. $7.50.

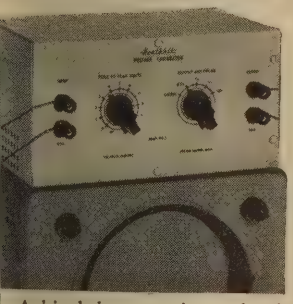


Heathkit SCOPE DEMODULATOR PROBE KIT

No. 337
SHIP. WT. 1 LB.
$4.50

Trouble shooting or aligning TV, RF, IF and video stages requires demodulation of high frequency signals before Oscilloscope observation. The HEATHKIT SCOPE DEMODULATOR PROBE KIT was specifically developed for this application. Kit consists of a probe housing, crystal diode detector circuit, shielded cable and spade lugs. Assembly is simple and the probe will quickly prove its usefulness as an Oscilloscope accessory.

NEW *Heathkit* VOLTAGE CALIBRATOR KIT



MODEL VC-1
SHIPPING WT. 5 LBS.
$9.50

Use the Heathkit Voltage Calibrator with your oscilloscope to measure peak-to-peak TV complex waveshapes. TV manufacturer's specifications indicate correct peak-to-peak voltages and this kit will permit making these important measurements.

A big help to engineers in circuit work. Makes peak-to-peak oltage measurements of complex waveshapes of all kinds. Flat pped semi-square wave output of calibrator assures fast and easy easurement of any voltage between .01 and 100V peak-to-peak.

The Voltage Calibrator can remain connected to your oscillope at all times for instant use. "Signal" position connects signal ade; study directly through calibrator and into scope input circuit r direct observation. Eliminates transfering leads from calibrator. *wonderful scope accessory.*

Heathkit ELECTRONIC SWITCH KIT

A few dollars spent for this accessory will increase the usefulness of a scope immeasurably. An electronic switch will open up a whole new field of scope applications for you. The S-2 allows TWO SIGNALS to be observed at the SAME TIME — this important feature allows you to immediately spot phase shift, clipping, distortion, etc. The two signals under observation can be superimposed or separated for individual study. Each signal input has an individual gain control for properly adjusting scope trace patterns. Has both coarse and fine frequency controls for adjusting switching time. Multivibrator switching frequency is from less than 10 cps to over 2000 cps in three overlapping ranges. Kit comes complete including 5 tubes, power transformer, all controls, instruction manual, etc. *Every scope owner should have one!*

MODEL S-2
SHIPPING WT. 11 LBS.
$19.50

EXPORT AGENT
OCKE INTERNATIONAL CORP.
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NEW YORK CITY (16)
CABLE: ARLAB-N.Y.

The HEATH COMPANY

. . . BENTON HARBOR 20, MICHIGAN

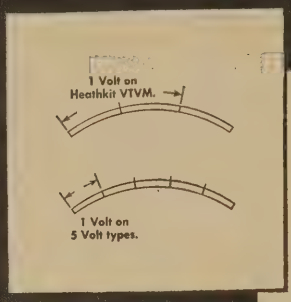
Heathkit VACUUM TUBE VOLTMETER KIT

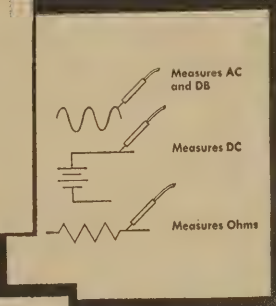
• NEW 1½ VOLT RANGE ON 1953 VTVM

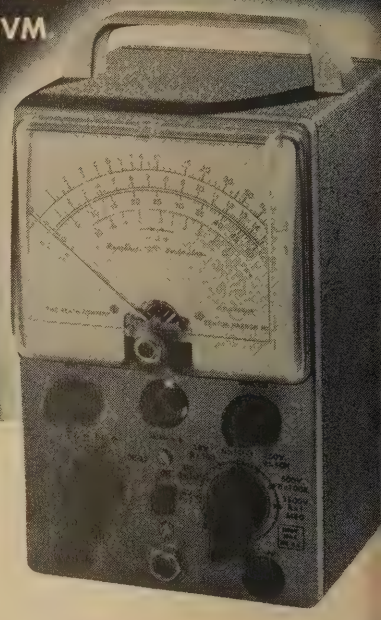
MODEL V-6

SHIPPING WT., 7 LBS.

$24.50







- New 1½ volt low range gives over 2" of scale per volt instead of less than ¾" found on 5 volt range type.
- Increased accuracy due to expanded scales.
- New 1500 volt DC high range gives 50% greater coverage.
- Seven ranges in all. 1½, 5, 15, 50, 150, 500 and 1500 volts DC (1000 volts maximum AC only).
- Provides proper service ranges 150 volts for AC DC work and 500 volts for AC type service.
- High input impedance, 11 megohms minimizes circuit loading.
- Variety of accessory probe kits available.
- 1% precision resistors in multiplier circuits.
- 200 microampere Simpson meter.
- Center scale zero adjust.
- Transformer operated.
- Test leads included.
- New cabinet styling.
- Large, clearly marked meter scales indicate ohms, AC volts, DC volts and DB.

The 1953 Heathkit V-6 VTVM has improved ranges! The lowest range has been moved way down to 1.5V full scale. This gives 3½" of actual scale length for the 1.5V covered — *that's 2⅓ inches per volt!!* Now you can make your low level measurements faster and with greater accuracy.

And the upper range has been moved up. *Readings up to 1500V DC* can be readily made with new, improved VTVM — plus readings up to 1000V on AC. Higher ranges for extended use.

New vertical chassis mounting gives added chassis space for really easy wiring — no tight corners to worry about. Uses only highest quality components throughout. Simpson 200 microampere meter movement combined with 1% precision resistors in multiplier circuit insu highly accurate and dependable readings.

AC and DC voltage ranges are 0-1.5V-5V-15V-50V-150V-500V-1500V. (1000V max. reading on AC — a total of seven ranges for convenient, accurate readings. Instrument also measures resistance from ohm to over 1 billion ohms in seven handy ranges of RX1, X10, X100, X1000, X10K, X1 Meg., — all co venient multiples of 10 with no skips. Has Db scale in red for easy indentification.

New panel has tough *baked on enamel finish* for freedom from scratches and maximum durability. Mode styled, formed, compact cabinet with rounded edges and crackle finish is truly handsome.

Comprehensive, detailed instruction manual with step-by-step instructions, figures, pictorials, etc. mak assembly a cinch.

Be sure and look over the special accessory VTVM probes below — for added usefulness.

Heathkit R. F. PROBE KIT

SHIP. WT 1 LBS. $5.50

No. 309

Extends RF range of HEATHKIT 11 megohm VTVM to 250 megacycles ± 10%.

Heathkit 30,000 V. D.C. PROBE KIT

SHIP. WT. 2 LBS. $5.50

No. 336

Provides DC multiplication factor of 100 for any 11 megohm VTVM.

Heathkit PEAK TO PE VOLTAGE PROBE KI

SHIP. WT. 2 LBS. $6.

No. 338

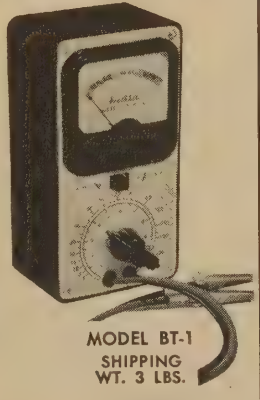
Reads on DC scal any 11 mego VTVM 5 kc t megacycle range.

NEW Heathkit BATTERY TESTER KIT

The new Heathkit Battery Tester measures all types of dry batteries between 1½ volts and 150 volts under actual load conditions. Readings are made directly on a three-color GOOD-WEAK-REPLACE scale that your customers can readily understand. Operation is extremely simple and merely requires that the leads be connected to the battery under test. Only one control to adjust in addition to a panel switch for A or B battery types.

The Heathkit Battery Tester features compact assembly. An accurate meter movement and wire wound control mount in the portable, rugged plastic case.

Use the BT-1 to check portable radio batteries, hearing aid batteries, lantern batteries and photo flash gun batteries.



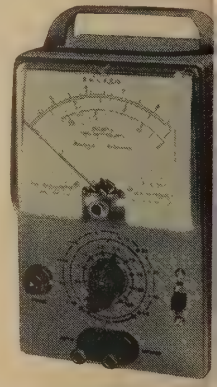
MODEL BT-1

SHIPPING WT. 3 LBS.

$7.50

Heathkit AC VACUUM TUBE VOLTMETER KIT

A new AC VTVM that makes possible those sensitive AC measurements required by laboratories, audio enthusiasts and experimenters. Ten full scale ranges of .01, .03, .1, .3, 1, 3, 10, 30, 100 and 300 volts RMS. 10 DB ranges from −52 to +52 DB. Frequency response within 1 DB from 20 cycles to 50 kc. Simpson 200 microampere meter with large plainly marked meter scales. Precision multiplier resistors. Two amplifier stages using miniature tubes. A unique bridge rectifier meter circuit and a clean layout of parts. Order the AV-2 today and become acquainted with the interesting possibilities offered by this instrument.



MODEL AV-2

SHIPPING WT. 5 LBS.

$29.50

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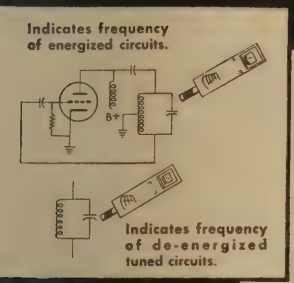
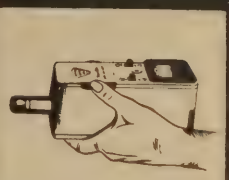
. . . BENTON HARBOR 20, MICHIGAN

NEW *Heathkit* GRID DIP METER KIT

• CONVENIENT ONE HAND OPERATION.





Complete unit easily held and operated with one hand.

MODEL GD-1

SHIPPING WT. 4 LBS.

$19.50

- New GRID DIP METER with assembled calibrated coils.
- Uses quality Simpson 500 microampere meter.
- One hand operation, extremely compact. Only 2½" wide by 3" high by 7" long.
- Variable meter sensitivity control.
- Uses newest type 6AF4 high frequency triode in a Colpitts oscillator circuit.
- Continuous coverage from 2 megacycles to over 250 megacycles in 6 ranges.
- Head phone monitoring jack.
- AC power transformer operated for maximum safety.

Here is the GRID DIP METER KIT you have been asking for. This new HEATHKIT instrument is compact, highly sensitive and easy to use. Housed in a handsome formed aluminum cabinet—rounded corners—durable oven baked finish on panel and cabinet. The entire instrument can be easily held and operated in one hand, tuning accomplished with the thumb wheel drive. This excellent design feature leaves the other hand entirely free for making circuit adjustments. The instrument with many applications — with oscillator energized, use it for finding the resonant frequency of tuned circuits, locating parasitics, determining characteristics of filter circuits, roughly tuning transmitter stages with power off, and neutralizing transmitters. Useful in TV and radio repair work for alignment of traps, filters, IF stages, peaking and compensation networks within the 2 to 250 megacycle range. With the oscillator not energized, the instrument acts as an absorption wave meter and indicates the frequency of radiating power sources. Locates spurious oscillations, as a relative indication of power in various transmitter stages, etc. Phone jack permits monitoring of AM transmitter for determination of radiated hum, audio quality, etc. (Head phones not included). Complete kit includes plug-in coils, tube, all necessary parts and detailed assembly and instruction manual.

Heathkit IMPEDANCE BRIDGE KIT

MODEL IB-1B

SHIPPING WT. 15 LBS.

$69.50

The HEATHKIT IMPEDANCE BRIDGE is especially useful in educational training programs, industrial laboratories and for experimental work. Use it for measuring AC and DC resistance value of resistors, termination of condenser capacitance and dissipation factor, finding coil ductance and storage factor, electrical measurements work, etc. Quality mponents: GR 1000 cycle hummer, GR main control, Mallory ceramic afer silver plated contact switches, ½% precision resistors, etc. The basic rcuit is a self powered, 4 arm bridge. Choice of Wheatstone, Capacitance mparison, Maxwell or Hay bridge circuits. Resistance from 10 milliohm 10 megohm. Capacitance 10 mmf to 100 mfd. Inductance 10 microhenry 100 henries. Dissipation factor .002 to 1. Storage factor (Q) 1 to 1000. he IMPEDANCE BRIDGE has provisions for external generator use for easurement at other than the 1000 cycle level. Take the guess work out electrical measurements. The HEATHKIT IMPEDANCE BRIDGE ounted in a beautiful polished birch cabinet with large easy reading panel ibrations will furnish years of accurate, trouble free measurement service.

Heathkit HANDITESTER KIT

The HEATHKIT Model M-1 HANDITESTER fulfills requirements for a portable volt ohm milliammeter. This kit features precision 1% resistors, 3 deck switch for trouble free mounting of parts, specially designed battery bracket, smooth acting ohms adjust control, beautiful molded bakelite case and a 400 microampere meter movement. 5 convenient AC and DC voltage ranges as follows: 10 - 30 - 300 - 1000 - 5000 volts. Ohms ranges 0 - 3000 and 0 - 300,000. DC milliampere ranges 0 - 10 milliamperes and 0 - 100 milliamperes. The instrument is easily assembled from complete instructions and pictorial diagrams. Test leads are included. Carry the HEATHKIT M-1 HANDITESTER in your tool box at all times for those simple jobs and eliminate that extra trip for additional testing equipment.

MODEL M-1

SHIPPING WT. 3 LBS.

$13.50

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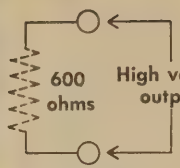
NEW *Heathkit* AUDIO GENERATOR KIT

• RANGE EXTENDED TO 1 MEGACYCLE

MODEL AG-8

SHIPPING WT. 16 LBS.

$29.50



Low impedance output
High voltage output

Sine wave output from 20 cycles to 1 megacycle.

- Improved design — new low price.
- Frequency coverage in five ranges from 20 cycles per second to 1 megacycle.
- Response flat 1 DB from 20 cycles to 400 kilocycles. Down 3 DB at 600 kilocycles. Down only 8 DB at 1 megacycle.
- Five calibrated output voltage ranges, continuously variable 1 mv, 10 mv, 100 mv, 1 v, 10 v.
- Low impedance output circuit. 600 ohms.
- Distortion less than .4 of 1% from 100 cycles per second through the audible range.
- New HEATHKIT universal type binding posts.
- Durable infra-red baked enamel panel.
- Transformer operated for safe operation.
- Sturdy, ventilated steel cabinet.

A new Audio Generator with features heretofore found in only the most expensive generators. Such features as complete coverage from 20 cycles to 1 Mc — response flat ±1 db from 20 cycles to 400 Kc, down 3 db at 600 Kc and down only 8 db at 1 Mc.

And it has calibrated output . . . Calibrated continuously variable and step attenuator output controls allow you to easily set calibrated output voltage. Moreover, distortion is less than .4 of 1% from 100 cps through the audible range.

Oscillator section consists of a two stage resistance coupled amplifier (6SJ7 and 6AK6) utilizing both positive and negative feedback for oscillator operation and reduction of distortion. Oscillator section drives a cathode follower output power amplifier (6AK6) which isolates the oscillator from variations in load and presents a low impedance output (600 Ohms). Power supply is transformer operated and utilizes 6X5 rectifier with 2 sections of RC filtering.

An unbeatable dollar value — for here is an audio generator with wide frequency coverage, excellent frequency response, stepped and continuously variable calibrated output, high signal level, low impedance output, and low inherent distortion.

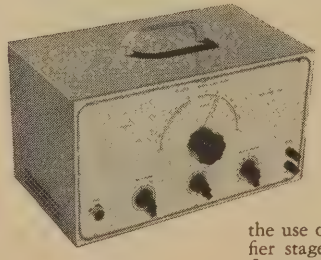
Heathkit AUDIO FREQUENCY METER KIT

The HEATHKIT AUDIO FREQUENCY METER provides a simple and easy way to check unknown audio frequencies from 10 cycles to 100 kc between 3 and 300 volts RMS. The instrument features 7 ranges for accuracy and wide coverage. The meter itself has a quality 200 microampere Simpson movement and large clearly marked scales. The AUDIO FREQUENCY METER is transformer operated and features a voltage regulator tube to maintain constant plate voltage on the second stage. Kit supplied complete with all necessary construction material and a detailed construction manual.

SHIPPING WT. 15 LBS.

MODEL AF-1 **$34.50**

NEW *Heathkit* AUDIO OSCILLATOR KIT



A new Audio Oscillator with both sine and square wave coverage from 20 to 20,000 cycles . . . An instrument designed to completely fulfill the needs of the audio engineer and enthusiast — Has numerous advantages such as high level output (up to 10V obtainable across the entire range), distortion less than .6%, and low impedance output.

Special design features include the use of a thermistor in the second amplifier stage for keeping the output essentially flat across the entire range.

A cathode coupled clipper circuit produces good, clean, square waves with rise time of only 2 microseconds. Oscillator section uses 1% precision resistors in range multiplier circuit for greatest accuracy.

You'll like the operation of this fine new kit.

MODEL AO-1
SHIPPING WT. 14 LBS.
$24.50

Heathkit SQUARE WAVE GENERATOR KIT

The HEATHKIT SQUARE WAVE GENERATOR is an excellent square wave frequency source with wide range coverage from 10 cycles to 100 kc continuously variable. This feature makes it useful for TV and wide band amplifier work as well as audio experimentation. The output voltage is continuously variable between 0 and 20 volts. The circuitry consists of a multivibrator stage, a clipping and squaring stage and a cathode follower low impedance output stage. The power supply is transformer operated and utilizes a full wave rectifier circuit with two sections of filtering. Another excellent HEATHKIT value at this remarkable low price. Kit includes all necessary construction material as well as complete instruction manual for assembly and operation.

MODEL SQ-1
SHIPPING WT. 14 LBS.
$29.5(

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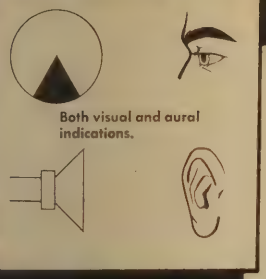
CABLE: ARLAB-N.Y.

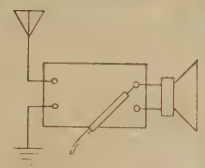
The HEATH COMPANY
. . . BENTON HARBOR 20, MICHIGAN

NEW *Heathkit* VISUAL-AURAL SIGNAL TRACER KIT

• NEW NOISE LOCATOR AND WATTMETER CIRCUITS.



Both visual and aural indications.



Traces signals from antenna clear through speaker.

MODEL T-3

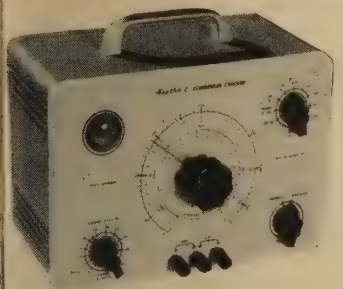
SHIPPING WT. 8 LBS.

$22.50

- Permits visual signal observation as well as aural operation.
- Two separate input channels.
- Tremendous RF channel sensitivity. Adequate for actual signal detection at receiver input.
- Separate high gain RF and low gain audio channels.
- A unique and useful noise locater circuit.
- Built-in calibrated wattmeter.
- Two separate shielded probes for RF and audio application.
- Additional test leads supplied.
- Substitution test speaker and output transformer eliminates necessity for speaker removal in service work.
- Utility amplifier. Check record changers, tuners, microphones, instrument pickups, etc.
- VTVM and Scope panel terminals.
- 5 tube transformer operated circuit.

The new HEATHKIT VISUAL AURAL SIGNAL TRACER represents one of the most convenient and useful instruments the service man can use in AM, FM and TV service work. The electron ray beam indicator constantly monitors both input channels for visual observation of the signal. Now, see and hear the signal level for easier estimation of signal strength and gain per stage in a receiver circuit. Separate high gain channel and special shielded demodulator probe for RF circuit work. Low gain channel for audio circuit investigation and for use as a noise locater. In this feature, approximately 200 volts DC is applied to a suspected circuit component and the action of the voltage in the component can be seen and heard to determine satisfactory operation. This feature alone will prove tremendously helpful in locating the source of objectionable noises in coils, transformers, resistors, condensers, cold solder joints, controls, etc. A convenient wattmeter permits rapid preliminary check for voltage distribution circuit breakdown as well as transformer failures. Use the T-3 as a universal test speaker and substitution transformer and save service time by eliminating the necessity for speaker removal on every service call. Additional service uses are: as a utility amplifier for checking the output of record changers, tuners, microphones, instrument pickups, etc. Separate panel terminals permit utilization of other shop equipment such as your Oscilloscope or VTVM. Entire kit supplied complete with 5 tubes, all necessary construction material along with a detailed step by step instruction manual for the assembly and operation of the instrument.

NEW *Heathkit* CONDENSER CHECKER KIT



MODEL C-3

SHIPPING WT. 7 LBS.

$19.50

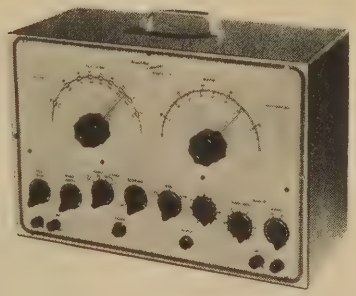
Announcing the new improved Model C-3 HEATHKIT CONDENSER housed in a new smartly styled professional appearing cabinet featuring rounded corners and snug fitting drawn panel. Adequate provisions for ventilation insures longer instrument life through cooler operation. Use the C-3 to accurately measure those unknown condenser and resistor values. All readings of condensers and resistors are read directly on the calibrated scales. Range of condenser measurements is from .00001 mfd to 1000 mfd. Calibrated resistance measurements can be made from 100 ohms to 5 megohms. A leakage test with a choice of 5 DC polarizing voltages will quickly indicate condenser operating quality under actual voltage load conditions. The spring return leakage test switch automatically discharges the condenser under test and eliminates shock hazard. An electron ray beam indicator tube is used in a new leakage test circuit for added sensitivity. The instrument is transformer operated for safety and will prove an extremely welcome addition to your shop equipment. The kit is furnished complete with all necessary parts, test leads and includes a step by step detailed construction manual for assembly and operation.

Heathkit TV ALIGNMENT GENERATOR KIT

MODEL TS-2

SHIPPING WT. 20 LBS.

$39.50



Here is an excellent TV ALIGNMENT GENERATOR designed to do TV service work quickly, easily and properly. The Model TS-2 when used in conjunction with an Oscilloscope provides a means of correctly aligning TV receivers. The instrument furnishes a frequency modulated signal covering in 2 bands the range of 10 to 90 megacycles and 150 to 230 megacycles. An absorption type frequency marker covers from 20 to 75 megacycles in 2 ranges: therefore you have a simple, convenient means of checking IF's independent of oscillator calibration. Sweep width is variable from 0 to 12 megacycles. Other excellent features are horizontal sweep voltage controlled with a phasing control — both step and continuously variable attentuation for setting the output signal to the desired level — a convenient stand by switch — and blanking for establishing a single trace with a base reference level. Make your work easier, save time and repair with confidence. Order your HEATHKIT TV ALIGNMENT GENERATOR now.

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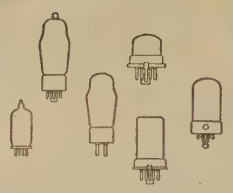
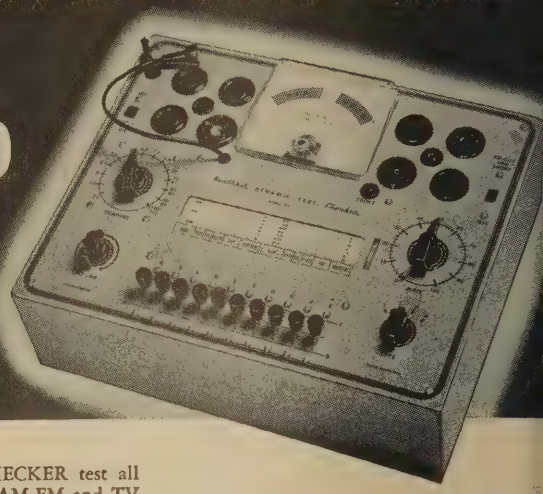
Heathkit TUBE CHECKER KIT



Checks 7, 8, 9 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, pilot lights.

Checks for opens, shorts, emission, filament and filament tap continuity.

MODEL TC-1
SHIPPING WT. 12 LBS.
$29.50



- Beautiful counter type birch cabinet.
- 4½" Simpson 3 color meter.
- Simplified setup procedure.
- Built-in gear driven roll chart.
- Checks emission, shorted elements, open elements and continuity.
- Complete protection against obsolescence.
- Sockets for every modern tube.
- Blank for new types.
- Individual element switches.
- Contact type pilot light test socket.
- Line adjust control.

PORTABLE TUBE CHECKER KIT MODEL TC-1P

Same as TC-1 except supplied with polished birch cabinet (with removable lid) instead of counter type cabinet. Shipping weight 14 lbs..... **$34.50**

No. 365 Polished Birch Tube Checker Cabinet only. Shipping Weight 7 lbs..... **$7.50**

With the HEATHKIT TC-1 TUBE CHECKER test all types of tubes commonly encountered in AM-FM and TV receiver circuits. Test setup procedure is simplified, rapid and flexible. Tube quality is read directly on a beautiful 4½" Simpson three color BAD - ? - GOOD scale that your customers can readily understand. Panel sockets accommodate 4, 5, 6 and 7 prong tubes, octals, loctals, 7 and 9 prong miniatures, 5 prong Hytrons, a blank socket for new tubes and a contact type socket for quick checking of pilot lights. Built-in gear driven roll chart for instant reference. Neon short indicator, individual three position lever switch for each tube element, spring return test switch, line set control to compensate for supply voltage variations. At this low price, no service man need be without the advantages offered by the HEATHKIT TUBE CHECKER.

Heathkit TV PICTURE TUBE TEST ADAPTER

Use your HEATHKIT TUBE CHECKER with this new TV TEST ADAPTER to determine picture tube quality. Check for emission and shorts, independent of TV power supply. Consists of standard 12 pin TV tube socket, 4 feet of cable, octal socket connector and data sheet. Quickly prove TV picture tube condition to yourself and your customer.

No. 355 Ship. Wt. 1 lb. **$4.50**

Heathkit RESISTANCE SUBSTITUTION BOX KIT

MODEL RS-1
SHIPPING WT. 3 LBS.
$5.50

NEW HEATHKIT RESISTANCE SUBSTITUTION BOX KIT provides switch selection of any single one of 36 RTMA 1 watt 10% standard value resistors, ranging from 15 ohms to 10 megohms. This coverage available in 2 ranges in decades of 15, 22, 33, 47, 68 and 100. Housed in rugged plastic cabinet featuring new HEATHKIT universal type binding posts. The entire kit priced less than the retail value of the resistors alone.

Heathkit BATTERY ELIMINATOR KIT

A clean 6 volt d-c supply source is definitely required for successful automobile radio servicing. Has a continuously variable d-c output from 0 to 8 volts. It can be safely operated at a steady 10 ampere level and will deliver up to 15 amperes for intermittent periods. The voltage output terminals are completely isolated from the chassis to accommodate additional service applications such as supplying bias voltages or d-c substitution voltages for battery operated tube filament circuits.

The output of the Battery Eliminator is constantly monitored by a d-c voltmeter and a d-c ammeter. The circuit features an automatic overload relay of self resetting type. For additional protection, a panel mounting fuse is provided. Build this kit in a few hours and pocket a substantial savings.

MODEL BE-3
SHIPPING WT. 20 LBS.
$24.50

Heathkit VIBRATOR TESTER KIT

Repair time is valuable, and the Heathkit Vibrator Tester will save you hours of work. Instantly tells the condition of the vibrator under test — and the check is thorough and complete. Checks vibrator for proper starting, and the easy-to-read meter indicates the quality of output on large BAD-GOOD scales. Tests both interrupter and selfrectifier types of vibrators. Five different sockets for checking hundreds of vibrators.

Operates from any battery eliminator capable of delivering continuously variable voltage from 4 - 6V at 4 amps. The Heathkit BE-3 Battery Eliminator is ideal for operating this kit.

Faulty vibrators can be spotted within seconds and you're free to go on to other service jobs.

MODEL VT-1
SHIPPING WT. 7 LBS.
$14.50

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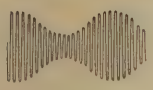
. . . BENTON HARBOR 20, MICHIGAN

Heathkit SIGNAL GENERATOR KIT



Modulated or unmodulated RF output.

400 cycle sine wave output.

MODEL SG-7

SHIPPING WT. 7 LBS.

$19.50

- Step attenuated RF ouput.
- 6 to 1 vernier dial ratio.
- Turret mounted coil sub-assembly.
- Pre-calibrated and adjusted coils.
- Hartley RF oscillator circuit.
- Colpitts oscillator 400 cycle sine wave output.
- Modulated or unmodulated RF output.
- Frequency coverage on fundamentals 160 kc to 50 megacycles in five ranges. 51 megacycles to 150 megacycles on calibrated harmonics.
- RF output in excess of 100,000 microvolts.
- Audio output 1½ to 2 volts.
- AC transformer operated.
- Professionally styled cabinet.
- Infra red baked enamel panel.

The new HEATHKIT Model SG-7 SIGNAL GENERATOR easily fulfills requirements for a controllable, modulated or unmodulated source of variable frequency. A convenient 400 cycle sine wave output is available for audio work. All RF oscillator coils are precision wound and adjusted to calibration before shipment thereby assuring maximum accuracy. The coils, band switch and tuning condenser all mount as a turret assembly so as to offer the advantage of short wiring leads and easy mounting of parts. The RF output circuit is of the low impedance type obtained by the use of cathode coupling to the output jacks. The level of RF output is varied by means of the RF step and RF output control. Use the HEATHKIT SG-7 as an RF signal source modulated or unmodulated for radio repair, laboratory work, experimental testing, 400 cycle sine wave audio testing, checking RF stages, alignment of both AM and FM IF stages, marker generator for TV alignment, etc. The kit is transformer operated and utilizes miniature tubes for ease in handling high frequency. Panel jacks and a convenient switching system permit either external or internal modulation. The entire kit is supplied complete with tubes and all necessary material as well as a detailed step by step instruction manual for the assembly and operation of the instrument.

Heathkit INTERMODULATION ANALYZER KIT

MODEL IM-1

SHIPPING WT. 18 LBS.

$39.50

The HEATHKIT MODEL IM-1 is an extremely versatile instrument specifically designed for measuring the degree of interaction between two signals caused by a specific piece of apparatus, or a chain of equipment. It is primarily intended for tests of audio equipment but may be used in other applications such as making tests of microphones, records, recording equipment, phonograph pickups and loud speakers. Use it for checking tape or disc recordings, as a sensitive AC voltmeter, as a high pass noise meter for adjusting tape bias, cutting needle pitch or other applications. High and low test frequency source, intermodulation section, power supply and AC voltmeter all in one complete unit. Percent intermodulation is directly read on three calibrated ranges, 30%, 10% and 3% full scale. Both 4 to 1 and 1 to 1 ratios of low to high frequencies easily set up. At this low kit price YOU can enjoy the benefits of Intermodulation analysis for accurate audio interpretations.

Heathkit LABORATORY REGULATED POWER SUPPLY KIT

MODEL PS-2

SHIPPING WT. 20 LBS.

$29.50

New HEATHKIT LABORATORY POWER SUPPLY provides continuously variable regulated DC voltage output from 160 volts to 400 volts depending on load. Panel terminals supply separate 6.3 V. AC supply at 4 amperes for filament circuits. A 3½" plastic cased panel mounted meter provides accurate metered output for either voltage of current measurements. Exceptionally low ripple content of .012% admirably qualifies the HEATHKIT LABORATORY POWER SUPPLY for high gain audio applications. Ideal for laboratory work requiring a reference voltage for meter calibration or for plotting tube characteristics. In service work, it can be used as a separate variable voltage supply to determine the desirable operating voltage in a specific circuit. Use it as a DC substitution voltage in trouble shooting TV circuits exhibiting symptoms of extraneous undesirable components in plate supply circuits. Entire kit, including all 5 tubes now available at this low price.

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CABLE: ARLAB-N.Y.

The HEATH COMPANY

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Heathkit WILLIAMSON TYPE AMPLIFIER KIT

The new HEATHKIT WILLIAMSON TYPE AMPLIFIER incorporates the latest improvements described in Audio Engineering's "Gilding the Lily." 5881 output tubes and a new Peerless output transformer with additional primary taps afford peak power output of well over 20 watts. Frequency response ±1 db from 10 cycles to 100 kc. allows reproduction of highs and lows with equal crispness and clarity. Harmonic and intermodulation distortion have been reduced to less than ½ of 1% at 5 watts. This eliminates the harsh unpleasant qualities which contribute to listening fatigue. Make this amplifier the heart of your radio system to achieve the fine reproduction that is the goal of all music lovers.

The HEATHKIT PREAMPLIFIER (available separately or in combination with the amplifier kit) features inputs for magnetic or low level cartridges, crystal pickups and tuners, turnover control for LP or 78 type records, individual bass and treble tone controls each providing up to 15 DB of boost or attenuation. Special notched shafts on preamplifier controls and switches adaptable to custom installation. The preamplifier can be mounted in any position and a liberal length of connecting cable is supplied. No radio experience is required to construct this amplifier. All punching, forming, or drilling has already been done. The complete kit includes all necessary parts as well as a detailed step by step construction manual with pictorial diagrams to greatly simplify the construction.

ACROSOUND TRANSFORMER OPTION. If desired, the output transformer with the kit will be the Acrosound output transformer, type TO-300. The use of this transformer permits ultra-linear operation as described in Audio Engineering's "Ultra-Linear Operation of the Williamson Amplifier."

PRICES OF VARIOUS COMBINATIONS

W-2 Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. **$69.50**

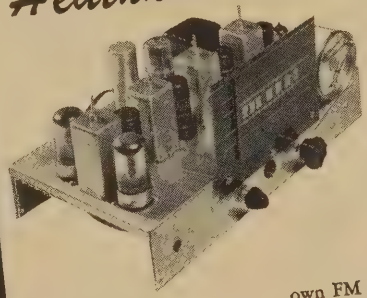
W-2M Amplifier Kit (Incl. Main Amplifier with Peerless Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only **$49.75**

W-3 Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer, Power Supply and WA-P1 Preamplifier Kit) Shipping Weight 39 lbs. Shipped express only **$69.50**

W-3M Amplifier Kit (Incl. Main Amplifier with Acrosound Output Transformer and Power Supply) Shipping Weight 29 lbs. Shipped express only **$49.75**

WA-P1 Preamplifier Kit only. Shipping Weight 7 lbs. Shipped express or parcel post. **$19.75**

Heathkit FM TUNER KIT



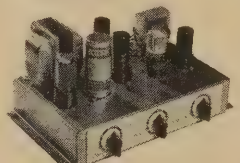
MODEL FM-2

SHIPPING WT. 9 LBS.

$22.50

The HEATHKIT MODEL FM-2 TUNER specifically designed for simplified kit construction features a preassembled and adjusted tuning unit. Three double tuned IF transformers and a discriminator transformer are used in an 8 tube circuit. Smooth tuning is obtained through a 9 to 1 ratio vernier drive using a calibrated six inch slide rule type dial. The usual frequency coverage of 88 to 108 megacycles is provided. Experience the thrill of building your own FM tuner. Operate it through your amplifier or radio and enjoy all the advantages of true FM reception. Transformer operated power supply to simplify connections to all types of audio systems. The kit is supplied complete with all 8 tubes and necessary material required for construction. A complete instruction manual simplifies assembly and operation.

Heathkit ECONOMY 6 WATT AMPLIFIER KIT



MODEL A-7

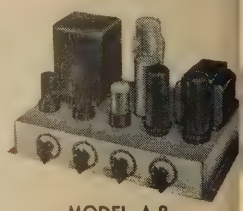
SHIPPING WT. 10 LBS.

$14.50

The HEATHKIT Model A-7 amplifier features beam power, push pull output with frequency response flat ±1½DB from 20 to 20,000 cycles. Separate volume, bass and treble controls. Two input circuits, output impedances of 4, 8, and 15 ohms. Peak power output rated at full 6 watts. High quality components, simplified layout, attractive gray finished chassis, break off type adjustable length control shafts and attractive lettered control panel.

THE MODEL A7A amplifier incorporates a preamplifier stage with special compensated network to provide the necessary voltage gain for operation with variable reluctance or low output level phono cartridges. Excellent gain for microphone operation in a moderate powered sound system..... **$16.50**

Heathkit HIGH FIDELITY 20 WATT AMPLIFIER KIT



MODEL A-8

SHIPPING WT. 19 LBS.

$33.50

The HEATHKIT MODEL A-8 amplifier kit was designed to deliver high fidelity performance with adequate power output at moderate cost. The frequency response is within ± 1 DB from 20 to 20,000 cycles. Distortion at 3 DB below maximum power output at 1000 cycles is only .8%. The amplifier features a Chicago power transformer in a drawn steel case and a Peerless output transformer with output impedances of 4, 8, and 16 ohms available. Separate bass and treble tone controls permit wide range of tonal adjustment to meet the requirements of the most discerning listener. The amplifier uses a 6SJ7 voltage amplifier, a 6SN7 amplifier and phase splitter and two 6L6's in push pull output and a 5U4G rectifier. Two input jacks for either crystal or tuner operation. The kit includes all necessary material as well as a detailed step by step construction manual.

MODEL A8-A features an added 6SJ7 stage (preamplifier) for operating from a variable reluctance cartridge or other low output level phono pickups. Can also be used with a microphone. A 3 position panel switch affords the desired input service. **$35.5**

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. . . BENTON HARBOR 20, MICHIGAN

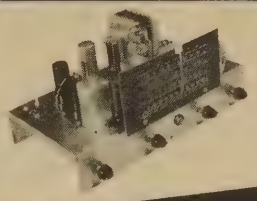
Heathkit SUPERHETERODYNE RECEIVER KITS

- High gain dual iron core tuned type IF transformers
- AC transformer operation for safety
- Continuously variable tone control
- Sturdy punched and plated steel chassis
- Ideal for custom installation
- Full AVC action
- Inverse feedback for improved frequency response
- Kit supplied with all necessary construction material except speaker and cabinet. (Available separately if desired).

6 tube all wave circuit. 3 ranges, continuous coverage 550 kc to over 20 megacycles, shipping wt. 11 lbs.

Model AR-1

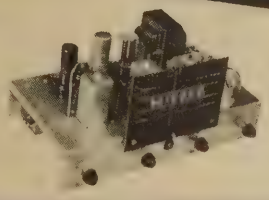
$23.50



5 tube broadcast band 550 to 1600 kc coverage, shipping wt. 11 lbs.

Model BR-1

$19.50



Two excellent radio receiver kits featuring clean design and open layout for simplified construction. Satisfy that urge to build your own radio receiver and select the model which meets your requirements. Both receivers feature continuously variable tone control, a radio phono switch and phono input and an AC receptacle for the phono motor. A six inch calibrated slide rule type dial with a 9 to 1 ratio vernier dial drive insures easy tuning.

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	Heathkit Oscilloscope Kit—Model O-8 (29 lbs.)	$43.50			Heathkit Square Wave Gen. Kit—Model SQ-1 (14 lbs.)	$29.50	
	Heathkit Intensifier Kit (0-8 only) No. 339 (1 lb.)	7.50			Heathkit AC VTVM Kit—Model AV-2 (5 lbs.)	29.50	
	Heathkit Voltage Calibrator Kit—Model VC-1 (5 lbs.)	9.50			Heathkit Intermodulation Analyzer Kit—Model IM-1 (18 lbs.)	39.50	
	Heathkit Electronic Switch Kit—Model S-2 (11 lbs.)	19.50			Heathkit Regulated Power Supply Kit—Model PS-2 (20 lbs.)	29.50	
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	Heathkit Q Meter Kit—Model QM-1 (12 lbs.)	39.50			Heathkit Decade Condenser Kit—Model DC-1 (4 lbs.)	16.50	
	Heathkit Grid Dip Meter Kit—Model GD-1 (4 lbs.)	19.50			Heathkit Impedance Bridge Kit—Model IB-1B (15 lbs.)	69.50	
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	Heathkit Battery Eliminator Kit—Model BE-3 (20 lbs.)	24.50			Williamson Type Amplifier Kit (Type:) Shipped express only		
	Heathkit Vibrator Tester Kit—Model VT-1 (7 lbs.)	14.50					
	Heathkit Audio Generator Kit—Model AG-8 (16 lbs.)	29.50			WA-P1 Preamplifier Kit (7 lbs.) (Shipped exp. or p.p.)	19.75	
	Heathkit Audio Oscillator Kit—Model AO-1 (14 lbs.)	24.50					
	Heathkit Audio Frequency Meter Kit—Model AF-1 (15 lbs.)	34.50					

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AUTOMATIC HEADLAMP CONTROL

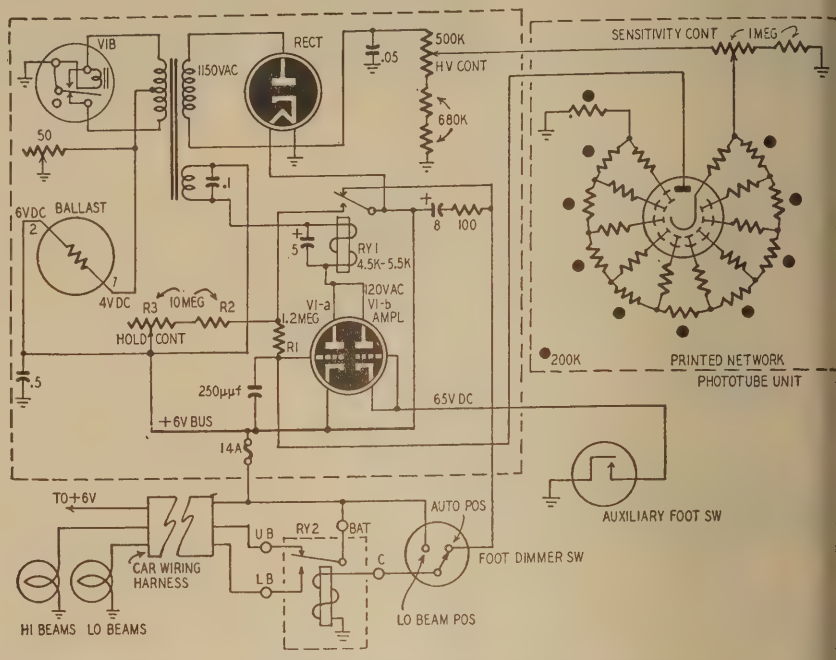

Fig. 1—Diagram of the Autronic-Eye photoelectric headlamp control unit.

AUTRONIC-EYE is the name of a new photoelectric automobile headlamp control developed by the Guide Lamp Division of General Motors. When installed on a car, it instantly and automatically adjusts the headlight beams for safest driving conditions. It shifts the headlights from upper beam (bright) to lower beam (dim) whenever another car approaches. It holds the lights on low beam until after the oncoming car or cars have passed—even though the approaching driver dims his lights as soon as he is within range. On brightly lighted streets and parkways, it lowers the beams and holds them down until the car enters a darkened area. By automatically performing these necessities for safe night driving, it relieves the driver of the responsibility of using the foot-operated dimmer switch and thereby increases driving safety.

The control unit is wired into the lighting system so it provides automatic selection of the proper driving beam for all conditions when the standard foot switch is in the upper-beam position. Throwing the foot switch to the low-beam position places the control unit on standby and holds the headlights on low beam continuously. An auxiliary foot switch enables the driver to override the control unit and momentarily switch from lower to upper beam regardless of the amount of light entering the phototube. This arrangement permits the driver to signal the driver of a car which he is overtaking or approaching head-on.

The *Autronic-Eye* (Fig. 1), is available as a factory installation on 1952 Oldsmobile and Cadillac cars. It consists of four basic parts:

The phototube unit mounts behind the windshield in the lower left corner. See Photo A. It consists of a photomultiplier tube and a lens and filter system designed for strict control over the horizontal and vertical angles of incoming light. The light falling on the phototube is converted to electrical impulses which raise and lower the headlight beams. The photomultiplier tube operates from a negative supply delivering approximately 1,000 volts. The SENSITIVITY control determines the voltage applied to the printed-circuit voltage-divider network which supplies proper operating voltages to the phototube dynodes. Photo B shows the phototube unit with the cover removed.

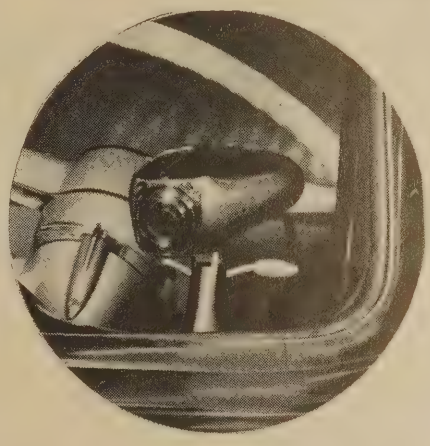

Photo A—The phototube unit mounts behind the windshield on the left side of the instrument panel. The prismatic lens concentrates light on the phototube.

Photo B—A close-up of the phototu unit with its top cover removed. Cli on the tube base connect leads to t printed-circuit voltage-divider networ

The amplifier unit contains the vibrator type power supply, a sensitive plate-circuit relay, and a twin-triode amplifier (relay control) tube. Signals from the phototube unit are fed into the amplifier tube which operates the sensitive relay RY1.

The power relay (RY2) is a heavy-duty unit which switches the headlights between upper and lower beams. It is wired so the upper beams are on when its field coil is unenergized. The relay coil is energized to turn on the low beams when the standard dimmer switch is in the low-beam position or when RY1 opens with the standa dimmer switch in the AUTOMATIC (hig beam) position.

The auxiliary foot switch is a no mally open, momentary contact, plung type unit which mounts on the flo boards near the standard dimm switch. It is used to override the co trol unit when the lights are dimm and the foot switch is on AUTOMA It provides the upper beam regardle of the amount of light entering t phototube unit.

How the circuit operates

The phototube operates with appro mately 1,000 volts negative on its ca ode and its plate returned to grou through R1, R2, and R3. These sistors serve as the plate load for t photomultiplier tube and as the g resistor for the triode-connected sect (V1-a) of the amplifier tube. The p totube does not pass plate current wh there is no light on its cathode. Wh

why guess?

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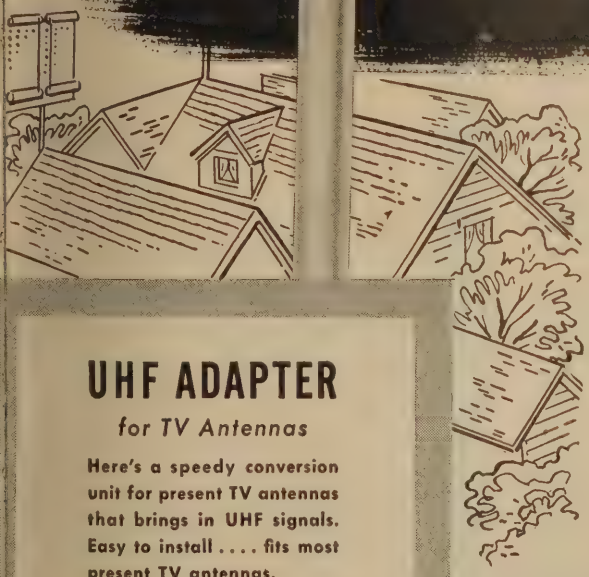

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- ★ *Uniform Gain . . . Low Standing Wave Ratio*
- ★ *300 Ohm Terminal Impedance*
- ★ *May Be Stacked . . . Measures 12 x 12 x 5 inches*

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light reaches the cathode, the pl current varies with the intensity the light.

When the phototube is dark, the fore, its plate current is very low the voltage drop across R1, R2, R3 is negligible. This places the g of V1-a very close to cathode poten so it conducts heavily. Relay RY1 clo and shorts out R2 and R3, thus bri ing the grid of V1-a still closer cathode potential.

When light strikes the cathode of phototube, its plate current cause voltage drop across R1. This makes grid of V1-a negative with respect the cathode. The plate current of V decreases and RY1 releases. This moves the short from across R2 and and makes the grid of V1-a still m negative to insure that RY1 rema open as long as there is light on phototube. It also protects the ph tube against excessive plate current increasing the load resistance.

As RY1 removes the shunt from and R3, it supplies 6 volts positive the coil of power relay RY2. This re pulls in and switches the headlig to low beam.

When the approaching car has pas or the car enters an unlighted a the phototube plate current decrea and V1-a draws enough current to erate RY1. This releases RY2 and turns the headlights to high beam.

The 8-μf capacitor and 100-ohm sistor suppress sparking which wo ruin the contacts of RY1 as they m and break the high-current line to R The 250-μμf capacitor filters out pow supply ripple.

The second section of the ampli tube (V1-b) is connected as a d with its plate tied to the plate of V Its grid and cathode connect to auxiliary foot switch. Pressing switch causes the diode to conduct pass enough current to operate so it releases RY2 and returns headlight to high beam. They ren in this position until the auxil switch is released.

The control unit operates from 6-volt electrical system in the auto bile. The amplifier unit houses a synchronous type vibrator supply w operates from 4 volts d.c. A ball tube type dropping resistor reduces voltage to approximately 4 at center-tap of the transformer prim The 50-ohm rheostat adjusts the age to exactly 4. The power tr former has two secondaries. One plies 1,150 volts a.c. to a high-vol rectifier tube. The other provides volts a.c. for the amplifier tube. amplifier and phototube are spec selected specimens of standard b tubes. Their type numbers were released by the manufacturer, ap ently because of the feeling that might lead to replacement with fact run tubes, which would probably a the performance unfavorably. The tifier and ballast tubes were spec made for the application. The 0 unit across the 120-volt secondar the buffer capacitor.

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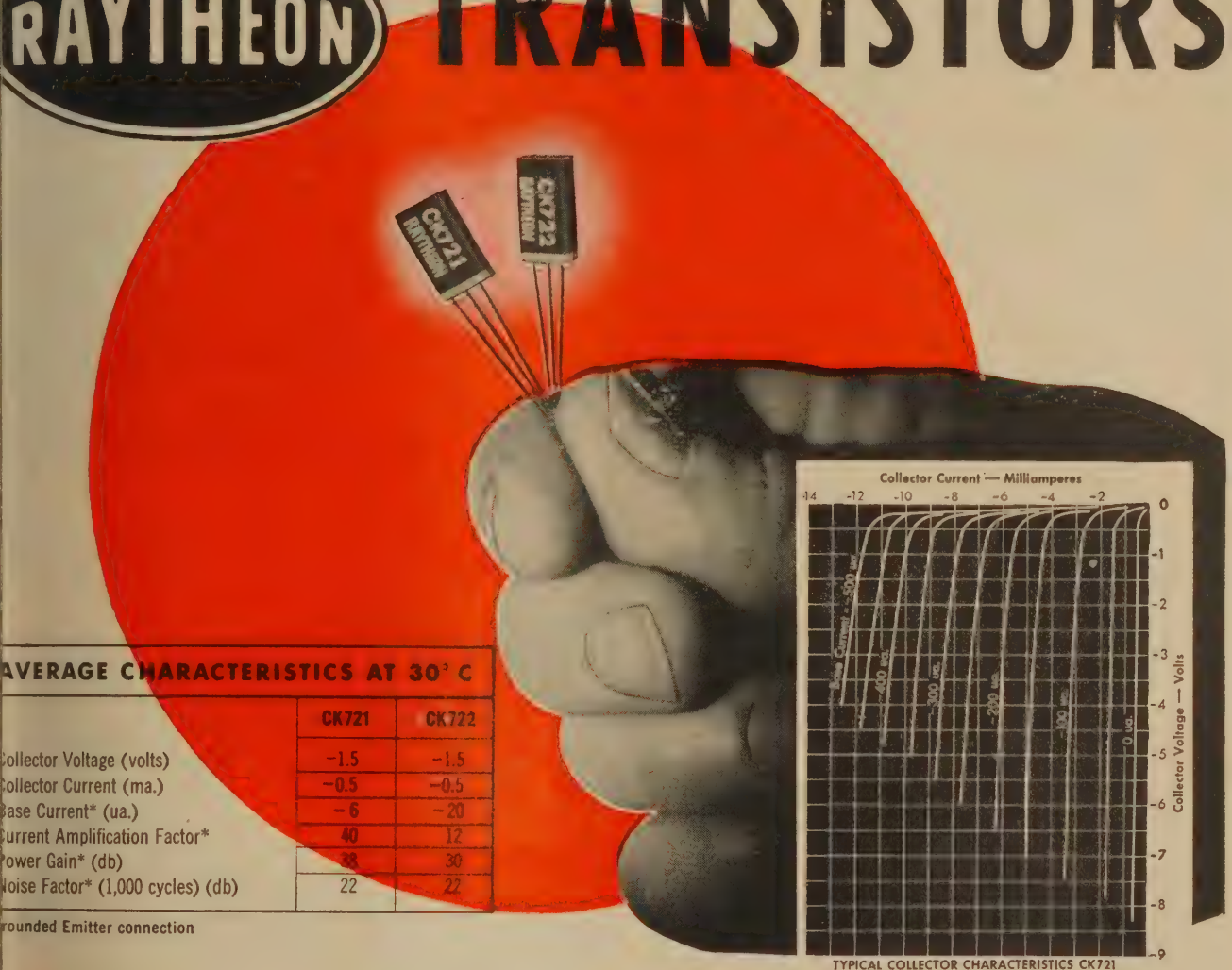
PNP GERMANIUM JUNCTION

RAYTHEON TRANSISTORS

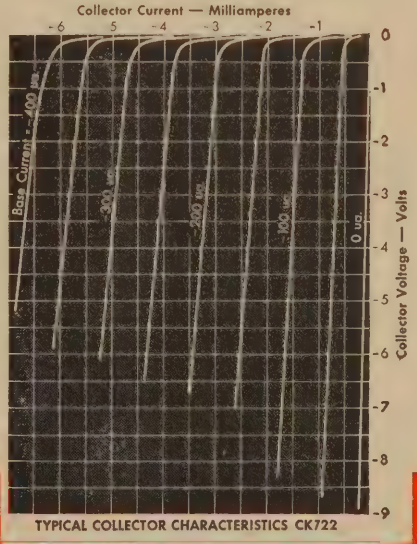


TYPICAL COLLECTOR CHARACTERISTICS CK721

AVERAGE CHARACTERISTICS AT 30° C

	CK721	CK722
Collector Voltage (volts)	-1.5	-1.5
Collector Current (ma.)	-0.5	-0.5
Base Current* (ua.)	-6	-20
Current Amplification Factor*	40	12
Power Gain* (db)	38	30
Noise Factor* (1,000 cycles) (db)	22	22

*Grounded Emitter connection



TYPICAL COLLECTOR CHARACTERISTICS CK722

For the first time in history, Germanium Junction Transistors are commercially available. Raytheon Junction Transistors, types CK721 and CK722 can now be obtained for your experimental and developmental use.

Here's another first for Raytheon! Leaders in the development and production of Electron Tubes and Germanium Products, Raytheon now leads the way in production of this important new electronic development.

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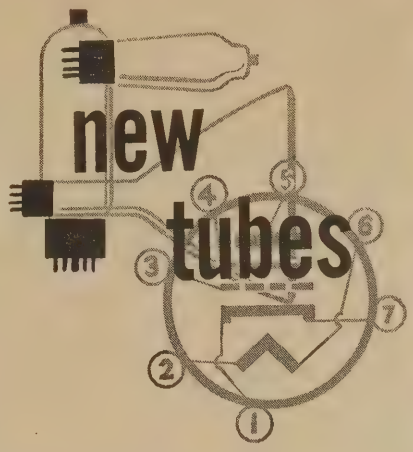
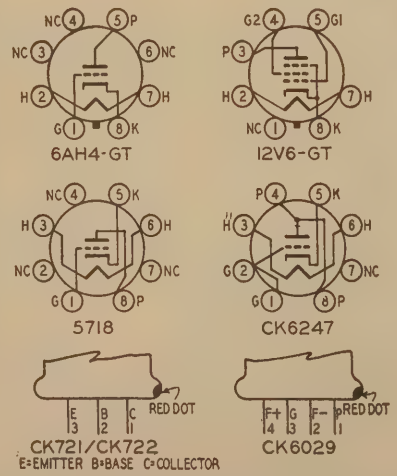


TWO types of Raytheon P-N-P junction transistors are now available from distributors. Type CK721 is a high-gain type with the following average gain characteristics (grounded emitter): Collector voltage, -1.5; collector current, -0.5 ma; base current, -6 μa; current amplification factor, 40; power gain (1,000-ohm source-20,000-ohm load), 38 db; noise factor at 1 kc, 22 db.

Type CK722 is a power-type junction transistor with the following average gain characteristics (grounded emitter): Collector voltage, -1.5; collector current, -0.5 ma; base current, -20 μa; current amplification factor, 12; power gain (1,000-ohm source-20,000-ohm load), 30 db; noise factor at 1 kc, 22 db.

Both types are only about ½ inch high, ¼ inch thick, and 5/16 inch wide, and have three flexible wire leads that may be trimmed to fit a standard "in-line" subminiature tube socket. The leads—reading from the red dot—are: 1—collector; 2—base; 3—emitter.

General Electric has introduced the 6AH4-GT, a new high-perveance triode for vertical-output service in television receivers. The 6AH4-GT can deliver the large deflection voltages required for modern rectangular picture tubes with relatively low plate voltage, and has improved insulation to withstand the high-amplitude pulses developed across the output-transformer primary during vertical retrace.



Basing diagrams of new tubes and junction transistors described in the text.

Typical operating conditions as a ver tical deflection amplifier: Plate volt 250; plate current, 30 ma; grid volt -33; amplification factor, 8; transcon ductance, 4,500 μmhos; plate resistanc 1,780 ohms. The 6AH4-GT has a 6. volt, 0.75-amp heater.

RCA's new 6BQ7-A is an improve version of the 6BQ7 low-noise dual tr ode, which it supersedes. The 6BQ7- has higher transconductance than th original type, while retaining the sam low input and output capacitances.

A typical cascode circuit for th 6BQ7-A is shown in Fig. 1. Heate

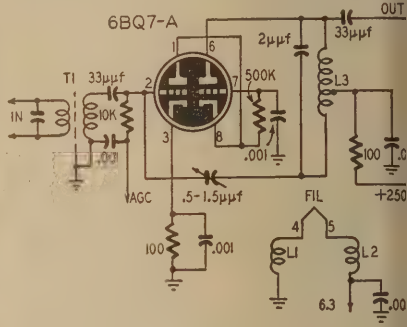


Fig. 1—Cascode-amplifier schematic

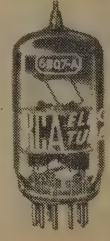
rating is 6.3 volts, 0.4 amp, and basi is the same as for the 6BZ7 describ in last month's RADIO-ELECTRONICS.

RCA has also introduced the 12V GT, an exact equivalent of the 6V6-G except for a heater rating of 12.6 vol 0.225 amp. The 12V6-GT is intended f use in equipment operating from 1 volt storage-battery supply.

Three new special types were a announced by RCA. The 5654 is a "p mium" version of the 6AK5, with sho resistant internal construction, and pure tungsten heater to withstand hi on-off switching rates. Grid 1 has be specially treated to reduce emissi

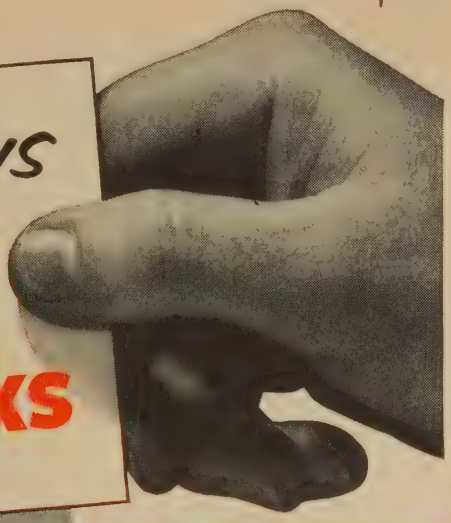
Type 5718 is a subminiature heat cathode medium-mu triode for oscil tor-power amplifier service at frequ cies up to 1,000 mc. It supersedes ty 5897. It has the following *maxim* ratings for class-C operation: Pl voltage, 165; plate current, 22 m grid current, 5.5 ma; d.c. grid volta -55 max; plate dissipation, 3.3 wat peak heater-cathode voltage (posit or negative), 200. High transcond tance (6,800 μmhos maximum) ma the 5718 useful also as a resistan coupled class-A amplifier.

RCA type 6211 is a new 9-pin min ture medium-mu twin triode for e tronic computers and on-off switch applications. Close matching of the triode units and a pure-tungsten volt-12.6-volt heater make the 6 especially suitable for counter circu



Let's forget the *"glittering generalities"* about quality.

Let's Check 4 specific ways CBS-HYTRON cuts your call-backs



1. BY MAKING CBS-HYTRON TV ORIGINALS BEST.

Longest experience with production . . . with applications . . . with improvements . . . all count. *CBS-Hytron-built* 1AX2, 1X2A, 6BQ6GT, 12A4, 12B4, 12BH7, 12BY7, 12BZ7, 25BQ6GT, 16RP4, etc. *are* more trouble-free. Prove it to yourself.

2. BY ENDLESSLY IMPROVING STANDARD TV TYPES.

Close co-operation with leading set makers alerts CBS-Hytron daily to needed betterments. Take one of endless examples: the CBS-Hytron 6CB6. You will find its clear, non-carbonized bulb eliminates undesirable loading effects at vhf.

3. BY APPLYING "RELIABLE" TUBE TECHNIQUES.

CBS-Hytron 6AL5 is typical. Experience with the military 6AL5 family (JAN 6AL5, 6097/CT, 5726) is passed on to you. You profit by a commercial CBS-Hytron 6AL5 made truly reliable.

4. BY MATCHING EACH TUBE TO THE SET.

Daily, CBS-Hytron analyzes leading TV chassis. Dynamic socket-by-socket checks, plus continuous field experience, pay off. Give you CBS-Hytron matched-to-the-set performance . . . with the accent on trustworthy replacements.

Take advantage of CBS-Hytron extras like these. Keep your customers happy. Guarantee yourself against profit-slicing call-backs. Demand dependable CBS-Hytron tubes.

NOW...TEST THE *EASY* TOPSIDE WAY!

Wish you could test a chassis topside? Without first pulling and wrestling with the heavy chassis? Without disturbing wiring and parts by digging underneath for buried sockets? How much faster, easier, safer you could work! New CBS-Hytron Test Adapter does the trick. Just replace a 7-pin miniature tube with the Test Adapter. Plug tube into Test Adapter. Presto, all socket connections are topside . . . within instant reach of your test prod or clip. Just one job pays for this new CBS-Hytron Test Adapter. Get yours today!

HERE'S HOW! With the CBS-Hytron Test Adapter, you quickly measure voltage, resistance, gain. You inject and trace signals . . . monitor intermittents. You check oscillating stages. Or the effect of adding a bypass condenser or shunt resistor.

With several CBS-Hytron Test Adapters you make stage-by-stage circuit checks . . . fast. You do all this dynamic testing the e-a-s-y way . . . topside. With no ill effects at a-f frequencies. And only slight capacitance and inductance effects at much higher frequencies.

You will like: The positive contact of the low-resistance, silver-plated base pins and test points. The plainly marked pin connections. The easy insertion and tight grip. CBS-Hytron Test Adapter is another designed-by-and-for-you "must" you must have. See your CBS-Hytron jobber today.

CBS HYTRON RADIO TUBES

HYTRON RADIO AND ELECTRONICS CO.

DANVERS, MASSACHUSETTS

While not a tube, the CBS-Hytron 1N64 germanium-crystal diode has been designed especially for use as a video detector in television receivers. It is suitable for use at the new 44-mc i.f. as well as at lower intermediate frequencies. The 1N64 has a peak-inverse rating of 20 volts and a total shunt capacitance of not more than 2 μμf. The molded phenolic case is ¼ inch in diameter and 13/32 inch long, with nickel-silver terminal pins and 1-inch copper-clad wire leads. Fig. 2 is a typical video-detector circuit using the new crystal.

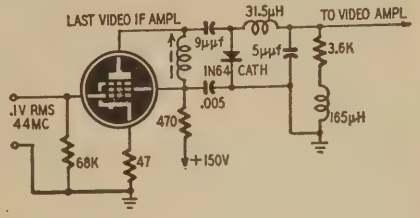


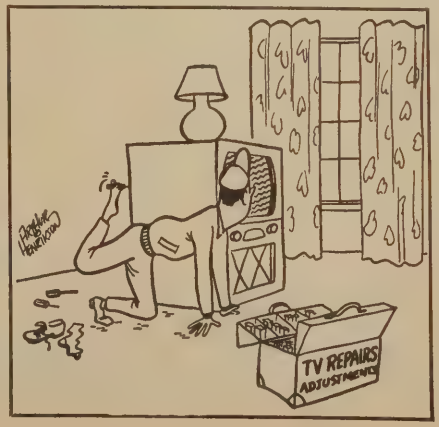
Fig. 2—Video-detector test circuit for determining characteristics of 1N64.

Raytheon has announced two additions to its line of subminiature tubes. The CK6029 is a subminiature triode designed for high-frequency oscillator service. At frequencies below 100 mc the CK6029 will deliver 1.1 watts output at a plate voltage of 135, and a plate current of 14 ma. Grid current is approximately 4 ma with a 5,000-ohm grid-leak resistor. The CK6029 may be used at frequencies as high as 400 mc.

Type CK6247 is a heater-cathode high-mu triode of special nonmicrophonic construction designed for equipment subject to severe vibration or mechanical shock. Typical characteristics as a class A1 amplifier: Heater voltage, 6.3 a.c. or d.c.; heater current, 0.2 amp; plate voltage, 250; plate current, 4 ma; cathode resistor, 500 ohms; amplification factor, 60; transconductance, 2,500 μmhos.

In addition to the receiving tubes described above, a number of special-purpose tubes have been announced by Amperex, Eitel-McCullough, General Electric, and Westinghouse. These include high-power, air-cooled transmitting tubes, radar types, and high-vacuum power rectifiers.

These will be described in detail as soon as full technical and physical information is available, and as space requirements permit. END



MERCHANDISE YOUR IDEAS FOR EXTRA PROFITS

Did you know that 5 out of every 6 TV sets are sold in metropolitan areas . . . well within the reception area of the Radion Metropolitan antenna? That's your BEST target area for extra profits. Here are some ideas to get them now! . . .

Big Replacement Market

It's rapidly becoming a big factor in antenna sales. There'll be 20 million sets in use this year. Even by the most conservative estimates, replacements are a huge market you can't afford to pass up! Keep a Metropolitan on display. Radion sells best over the counter because it's the one antenna folks recognize. That $6.95 list gives you a fine spread and remember, sell just TEN antennas and you've earned as much profit as you'd make on a table model TV set.

Let Deliverymen Install

Save time and money . . . keep your TV technicians free for service calls and shop work. With Radion, the man who delivers the set installs the antenna. Radion saves on antenna complaints too because the customer adjusts his own antenna.

Sell on Service Calls

Frank Moch of NATESA estimates that there'll be 26 MILLION service calls in 1953. Each call is an opportunity to sell an accessory. Have your technicians carry a Radion Metropolitan as a replacement antenna or, if it's an outside installation, sell a Radion lightning arrester. Remember, the initial sale is an invitation to further selling. Check your customer list . . . it's a constant source of business for you.

RADION Sells TV Trade-ins

Those traded-in sets may seem like a headache to you but there's a big market for used and small-screen sets. Add a Radion Metropolitan in a flat-price package deal . . . "complete with antenna!" You'll find it a natural for extra sales.

Fans Buy Radions for FM

The Radion Metropolitan with its adjustable dipoles makes a fine FM antenna. Remember the sound on TV is FM too. Sell Radions right out of your TV antenna inventory for extra profits.

New Lightning Arrester a Natural

Radion's new *all-purpose* arrester is proving a terrific source of extra profits. Cuts your inventory problems because it fits all twin leads, mounts anywhere, comes complete with hardware. Sell an arrester with every outdoor installation. See Radion's handsome new display package. It's a top "silent salesman" for your counter.

FREE PRIZES FOR YOUR IDEAS

Selling more TV helps you — helps us. Let's exchange our proven ideas for extra profits. Send ideas you've tried successfully to Radion. If we print them, we'll send you your choice of a case of 12 antennas or 24 lightning arresters. Send as many ideas as you like. In case of duplication, first letter received wins, so write now!

Get On The Profit Bandwagon—Send This Coupon Today

Radion

The Radion Corp., 1130 W. Wisconsin Ave.
Dept. RE-1, Chicago 14, Illinois
Send me free Radion profit plan folder

Name_____

Firm_____

Address_____

Export Sales Division: Scheel International, Inc., 4237 Lincoln Ave., Chicago 18, Ill., U.S.A. Cable Address—HARSCHEEL

SHORT-WAVE REGENERATOR FOR THE AMATEUR OR SWL

MANY of the younger hams and would-be SWL's are inactive because they cannot afford the price of a communications receiver. Having grown up in the age of the chrome-plated superdooper superhets with dual conversion, crystal filters, and a host of other fancy gadgets and attachments, they do not realize that for about $15 or less they can construct a short-wave receiver which will often outperform communications type sets selling for nearly $100.

A simple 3-tube receiver tuning from 3.5 to above 30 mc is a nice starting point for persons who cannot afford the receiver of their dreams. Such a set was described in *Radio and Electronics* (Wellington, New Zealand). Its circuit is shown in the diagram.

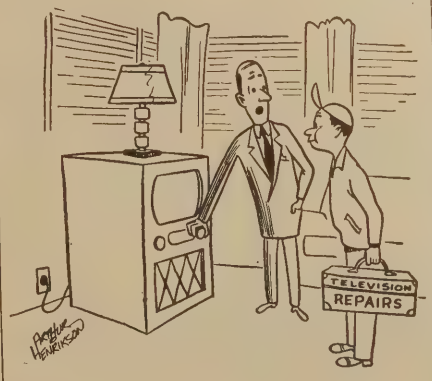
V1 is the r.f. amplifier, V2 is a regenerative detector, and V3 is the a.f. amplifier. Regeneration is controlled by varying the screen-grid voltage of V2. The detector plate load L5 may be an audio choke of several hundred henries or the primary of an inexpensive step-up type audio interstage transformer. The secondary is not used. The resistor across L5 prevents fringe howl—a loud screeching type of audio oscillation which may be heard when the regeneration control is set so the oscillator is on the verge of oscillation. The exact value will have to be found by trial. Use the largest value which prevents the howl. If the condition recurs after the batteries have aged, replace the shunt resistor with one of a slightly lower value.

Follow these rules when constructing the receiver:

1. Lay out the components so the r.f. leads are as short as possible.

2. Shield the antenna coil (L1-L2) and its tuning capacitor from the r.f. coil (L3-L4) and its tuning capacitor. Partition shields or compartments on the chassis will usually do the trick.

3. Connect bypass capacitors as close as possible to the elements which they



"We didn't want to bother you with minor adjustments so we tinkered with it until now it just won't work at all!"

BUY TEST EQUIPMENT ON THIS RADICALLY NEW TIME PAYMENT PLAN

NO INTEREST!! - NO CARRYING CHARGES!!

USE CONVENIENT TIME PAYMENT ORDER BLANK BELOW

Superior's New

JUNIOR SUPER-METER

MOST COMPLETE AND COMPACT MULTI-SERVICE INSTRUMENT EVER DESIGNED

Measures:
* Voltage * Current * Resistance
* Capacity * Reactance * Inductance
* Decibels

Specifications: D.C. Volts: 0–7.5/75/150/750/1500 Volts. A.C. Volts: 0–15/150/300/1500/3000 Volts. Resistance: 0–10,000/100,000 ohms. 0–10 Megohms. D.C. Current: 0–7.5/75 Ma. 0–7.5 amps. Capacity: .001 Mfd.—.2 Mfd. .1 Mfd.—20 Mfd. Electrolytic Leakage: Reads quality of electrolytics at 150 Volt test potential. Decibels: —10 Db to +18 Db. +10 Db to +38 Db. +38 Db. to +58 Db. Reactance: 15 ohms—25 K ohms 15 K ohms—2.5 Megohms. Inductance: .5 Henry—50 Henries 30 Henries—10 K Henries. Plus Good-Bad scale for checking the quality of electrolytic condensers.

Handsome round cornered molded bakelite case 3⅛" x 5⅞" x 2¼" complete with all test leads and instructions ..... **$21.40 NET**

Superior's New Model TV-11

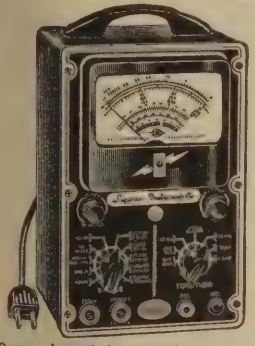
TUBE TESTER

• Uses the new self-cleaning Lever Action Switches for individual element testing. Because all elements are numbered according to pin number in the RMA base numbering system, the user can instantly identify which element is under test. Tubes having tapped filaments and tubes with filaments terminating in more than one pin are truly tested with the Model TV-11 as any of the pins may be placed in the neutral position when necessary. • Uses no combination type sockets. Instead individual sockets are used for each type of tube. Thus it is impossible to damage a tube by inserting it in the wrong socket. • Free-moving built-in roll chart provides complete data for all tubes. • Phono jack on front panel for plugging in either phones or external amplifier detects microphonic tubes or noise due to faulty elements and loose external connections.

Operates on 105-130 Volt 60 Cycles A.C. Hand-rubbed oak cabinet complete with portable cover **$47.50 NET**

Superior's New Model 670-A

SUPER-METER



A combination **volt-ohm milliammeter plus capacity reactance inductance and decibel measurements**

SPECIFICATIONS:

D.C. VOLTS: 0 to 7.5/15/75/150/750/1,500/7,000 Volts
A.C. VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
OUTPUT VOLTS: 0 to 15/30/150/300/1,500/3,000 Volts
D.C. CURRENT: 0 to 1.5/15/150 Ma. 0 to 1.5/15 Amperes
RESISTANCE: 0 to 1,000/100,000 Ohms 0 to 10 Megohms
CAPACITY: .001 to 1 Mfd. 1 to 50 Mfd. (Quality test for electrolytics)
REACTANCE: 50 to 2,500 Ohms 2,500 Ohms to 2.5 Megohms
INDUCTANCE: .15 to 7 Henries 7 to 7,000 Henries
DECIBELS: —6 to +18 +14 to +38 +34 to +58

Comes housed in rugged, crackle-finished steel cabinet complete with test leads and operating instructions. Size 6¼" x 9¼" x 4½". **$28.40 NET**

ADDED FEATURE
The Model 670-A includes a special GOOD-BAD scale for checking the quality of electrolytic condensers at a test potential of 150 Volts.

Superior's New

TV BAR GENERATOR

THROWS AN ACTUAL BAR PATTERN ON ANY TV RECEIVER SCREEN!!

Connects direct to antenna post. No connection inside receiver.

Features—Can be used when no stations are on the air. • Provides linear patterns to adjust vertical and horizontal linearity • Provides vertical and horizontal sweep signals • Provides signal for testing video amplifiers.

TV Bar Generator comes complete with shielded leads and detailed operating instructions. Only ..... **$39.95 NET**

Superior's Model 660-A—A NEW A.C. OPERATED

SIGNAL GENERATOR

Provides Complete Coverage for A.M.—F.M. and TV Alignment

• Generates Radio Frequencies from 100 Kilocycles to 60 Megacycles on fundamentals and from 60 Megacycles to 220 Megacycles on powerful harmonics. • Accuracy and stability are assured by the use of permeability trimmed Hi-Q coils. • R. F. available separately or modulated by the internal audio oscillator. Built in 400 cycle sine wave audio oscillator used to modulate the R. F. signal also available separately for audio testing of receivers, amplifiers, hard of hearing aids, etc. • R. F. Oscillator Circuit: A high transconductance heptode is used as an R. F. oscillator, mixer and amplifier. Modulation is effected by electron coupling in the mixer section thus isolating the oscillator from load changes and affording high stability. • A. F. Oscillator Circuit: A high transconductance heptode connected as a high-mu triode is used as an audio oscillator in a high-C Colpitts Circuit. The output (over 1 Volt) is nearly pure sine wave. • Attenuator: A 5 step ladder type of attenuator is used.

• Tubes used: 1—6BE6 as R. F. Oscillator, mixer and amplifier. 1—6BE6 as Audio Oscillator. 1—6H6 as Power Rectifier.

The Model 660-A comes complete with coaxial cable, test lead and instructions ..... **$42.95 NET**

NEW TIME PAYMENT PLAN ORDER BLANK

MOSS ELECTRONIC DISTRIBUTING CO., INC.
Dept. B-50, 38 Murray Street, New York 7, N. Y.

Please send me the units checked below. I am enclosing the down payment with order and agree to pay the monthly balance as shown. It is understood there will be no carrying, interest or any other charges, provided I send my monthly payments when due. It is further understood that should I fail to make payment when due, the full unpaid balance shall become immediately due and payable.

☐ JUNIOR SUPER METER .....Total Price $21.40
$5.40 down payment. Balance $4.00 monthly for 4 months.
☐ MODEL TV-11 .....Total Price $47.50
$11.50 down payment. Balance $6.00 monthly for 6 months.
☐ MODEL 670-A .....Total Price $28.40
$7.40 down payment. Balance $3.50 monthly for 6 months.
☐ TELEVISION BAR GENERATOR .....Total Price $39.95
$9.95 down payment. Balance $5.00 monthly for 6 months.
☐ MODEL 660-A .....Total Price $42.95
$12.95 down payment. Balance $5.00 monthly for 6 months.

☐ I enclose $_____ as down payment.
☐ Ship C.O.D. for the down payment.

Signature_____

Name_____

Address_____

City_____ Zone_____ State_____

bypass. Use a common ground point for each stage.

4. Use low-loss coil forms and sockets for optimum performance.

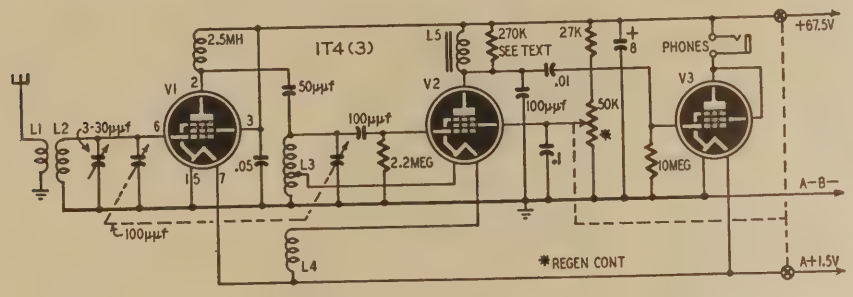
5. Erect a good, high, long-wire antenna for best all-wave reception.

Coil Table

Coils	L1	L2	L3	Tap on L4	Tap on L3
Band A No. of turns	5	26	26	3½	3½
Band B No. of turns	4½	13	13	2½	2½
Band C No. of turns	2½	5½	5½	2½	2½

Note All coils are wound on 1¼-inch forms. No. 30 enameled wire is used for L2 and L3 on band A and No. 20 wire is used on bands B and C. No. 30 wire is used for L1 and L4 on all bands. The turns of L2 and L3 are spaced the diameter of the wire on all bands. L1 is interwound with the turns at the ground end of L2, and L4 is interwound with the turns at the ground end of L3.

(Many regenerative receivers develop hand capacity—an odd type of instability manifested by a variation of tuning as the hand is brought close to the set. This trouble can be minimized by building the set with a grounded metal panel and chassis and by inserting a 2.5-mh choke between the plate of V2 and the junction of L5 and the .01-μf and 100-μμf capacitors. Connect a 100-μμf capacitor from the plate of V2 to ground.—*Editor*) END



Materials for receiver

Resistors: 1—27,000, 1—270,000 ohms, ½ watt; 1—2.2, 1—10 megohms, ½ watt. 1—potentiometer, 50,000 ohms, with d.p.s.t. switch.

Capacitors: (Mica or ceramic) 1—50, 2—100 μμf. (Paper) 1—.01, 1—.05, 1—0.1 μf, 400 volts. (Electrolytic) 1—8 μf, 150 volts or more. (Variable) 1—midget, 2 gangs, 100 μμf per section; 1—air trimmer, 30 μμf.

Miscellaneous: 1—R.f. choke, 2.5 mh receiving type. 1—Audio choke (see text). 3—Tubes, 1T4. Sockets, chassis, panel, coil forms, wire, and hardware.

HAM COMMITTEES HELP

The FCC reports that TVI has been greatly minimized in a year of cooperative endeavor. Local TVI committees, formed either of amateurs or of the combined forces of local hams, service technicians, TV dealers, and other interested groups, are responsible for much of the progress. There are more than 177 committees in the U. S.

Local committeemen are able to investigate complaints directly, correct actual faults of amateur transmission, assist TV owners to install filters where needed, and carry on an educational campaign to improve good will.

Some interesting cases have come up in the work of the committees. In one case a TV set owner was so pleased when his TVI was cleared up that he wanted to make sure that a neighboring amateur could also resume normal operation. In another puzzling case, the owner reported that there was "an awful squealing" on his TV every Friday night while the wrestling matches were broadcast. Others in the area were not affected, and checks on the set showed normal operation. Finally a delegation from the local TVI committee visited the set on a Friday night.

One other factor—overlooked by the owner—was also present. The committee found another visitor, an elderly uncle who always came to see the wrestling. The squealing stopped when uncle's hearing aid was turned off. Oscillation due to run-down batteries was the source of the interference. END

Extra profits for servicemen!

NOW you can add UHF to the thousands of VHF Super Fans presently installed in your area, with Channel Master's exclusive new Ultra-Dapter, Model No. 414. In 5 minutes you can convert any Super Fan into an all-channel VHF-UHF antenna. See your distributor for details.

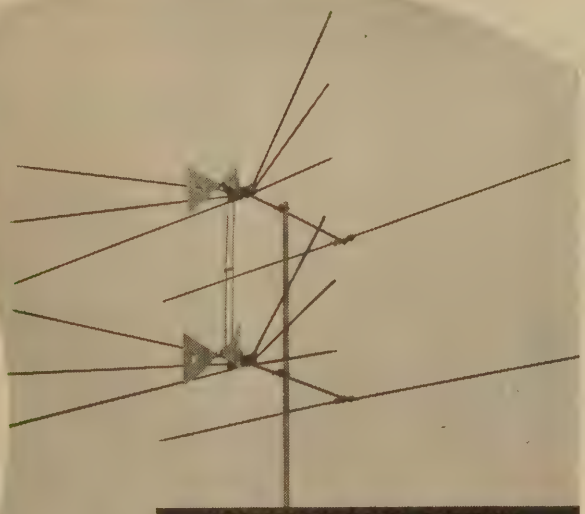
VHF *and* UHF

Now! Get all 82 channels

with the *new*

CHANNEL MASTER ULTRA FAN

Single Bay model no. 413 | **Stacked model no. 4132**



Write for literature on Channel Master's new complete line of UHF antennas including such models as these:

Ultra Bow Model No. 401

Ultra Bow with screen reflector Model No. 402

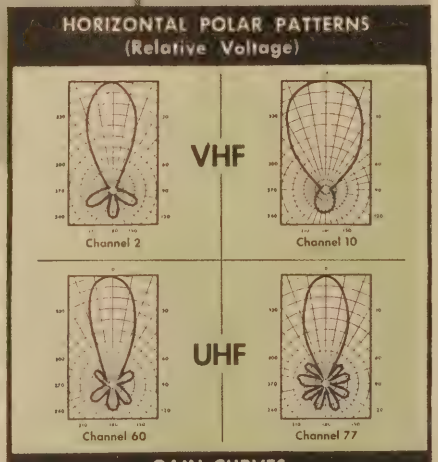
Ultra Vee Model No. 404

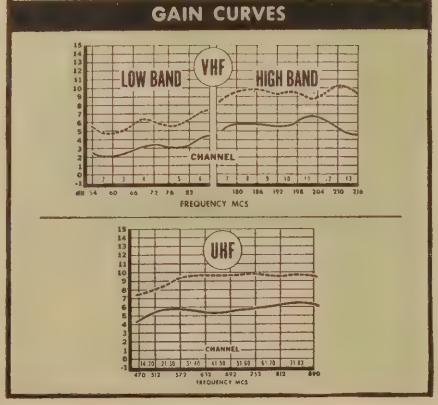
Today's most sensitive ALL-VU* antennas!

*All VHF, All UHF

Featuring:

- **2 great antennas in 1 —** A genuine, high gain Super Fan on VHF, and an all-channel Triangular Dipole and reflector for peak UHF reception.
- **Electronic inter-action filter —** Automatically isolates VHF and UHF bands, eliminates inter-action. Ultra Fan operates with only a *single* transmission line to TV set.
- **"Free space" terminals —** Channel Master's *exclusive* UHF "free space" terminals prevent accumulation of dirt and moisture which gradually reduce picture quality in ordinary UHF installations.
- **Famous Channel Master engineering —** The Ultra Fan is an *integrated* VHF-UHF antenna that give uniformly high gain over *all* TV channels, from 2 through 83.





——— Single Bay
– – – – Stacked

MEMBER ANTENNA MANUFACTURERS ASSOCIATION

CHANNEL MASTER CORP. ELLENVILLE, N. Y.

STILL ANOTHER CODE

Some interesting points appear in the code below, adopted by a dealers' organization. The Radio and Television Dealers of Bridgeport (Conn.) feel that the code will help them in their objective of stabilizing professional ethics:

Completion of all work in a neat, competent manner to the best of the member's ability.

Treatment of the customer's property with due care and consideration.

Making no unreasonable promises.

Rendering an accurate statement to customers for services performed.

Keeping records of all work performed.

Refraining from making derogatory comments or unjust criticism of work of a competitor.

The use of replacement parts of equal quality or better quality than those used originally.

Guaranteeing all work for a reasonable length of time.

Handling all complaints promptly and courteously.

Refraining from misleading advertising.

Maintaining a reasonable personal appearance.

Conducting a business reflecting credit on the entire radio and television industry.

Rendering technical assistance to fellow members.

Transacting business with parties conducting business in accordance with fair business practices.

Observing the Golden Rule.

The association also intends to set up a committee to investigate complaints against TV and radio dealers and to undertake a campaign of education of the public.

MIMEOGRAPH FOR MEMBERS

According to the December, 1952, issue of the *ARTSD News* (Columbus, Ohio), a mimeograph machine is available to members for printing forms, work orders, or other material. The machine was originally purchased to publish the monthly newsletter of the organization (Associated Radio-Television Service Dealers of Columbus) and is available to all members whenever it is not in use getting out the official organ.

In the same issue, the *News* reports that the association is considering widening its membership area and has authorized the board of directors to consider admitting members from outside Franklin County.

The passing of Jim Long, one of the earliest members of the organization and a radio service technician since 1920, was also noted in the issue.

LICENSING IN PHILLY

Status of the slightly complex licensing situation in Philadelphia is possibly best presented in the letter below, written by the Television Contractors Association to Mrs. Constance Dallas, city councilwoman who intends to introduce a city licensing bill:

FAR BETTER RECEPTION

IN EVERY LOCATION

with Sensational New

TRIO ZIG-ZAG

Patent Pending

TV ANTENNAS

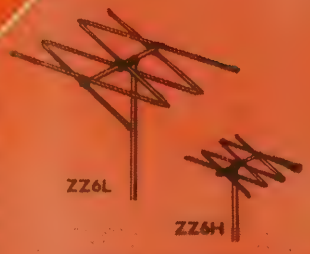
SUBURBAN MODELS

Models ZZ4A and ZZ6A give you all-channel (2 thru 13) reception in ONE SINGLE BAY ANTENNA. The Model ZZ4A has excellent gain and is designed for suburban areas. Model ZZ6A has even greater gain and provides excellent all-channel reception in near fringe areas.

From ultra-ultra fringe to metropolitan areas, the sensational new TRIO ZIG-ZAG TV Antennas are providing clear, enjoyable TV pictures.

Enthusiastic reports are pouring in from across the nation, testifying to the high efficiency of the new, exclusive TRIO ZIG-ZAG TV Antenna design.

Yes, results — not mere claims — have made the TRIO ZIG-ZAG America's most wanted TV antenna!



NEAR FRINGE MODELS

For near fringe area reception, the Models ZZ6L and ZZ6H are recommended. Model ZZ6L covers Channels 2 thru 6, Model ZZ6H is for Channels 7 thru 13. Both antennas offer high gain with patterns and front-to-back ratios similar to cut-to-channel yagis.

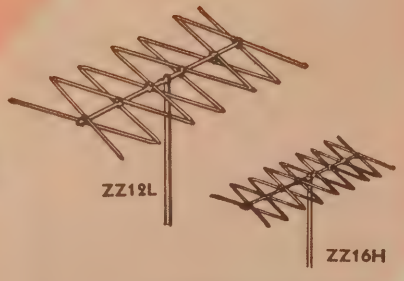
FRINGE MODELS

Models ZZ8L and ZZ8H were designed for normal fringe area reception and provide clear, snow-free pictures. Forward lobe patterns and front-to-back ratios are similar to a good single channel, multi-element yagi.

TRIO ROTATOR AND DIRECTION INDICATOR

The TRIO Rotator is America's most dependable — has two powerful 24 volt motors — one for each direction of rotation. Absolutely weatherproof, permanently lubricated. All motors, shafts and gears mounted on a rugged, one-piece casting for true alignment, strength and longer life. Every TRIO Rotator fully guaranteed for two years! Beautiful Direction Indicator has "finger tip" control — no need to hold knob for rotation. A touch of the finger starts it — a touch stops it!

ZZ12L and ZZ16H are stacked for all VHF Channel Reception



ULTRA FRINGE MODELS

The extremely high gains of the ZZ12L and the ZZ16H models provide unequalled reception in ultra-fringe areas. Model ZZ12L covers Channels 2 thru 6 and Model ZZ16H, Channels 7 thru 13. These two models when stacked, are fed with only one 300 ohm line and provide ALL VHF CHANNEL RECEPTION. Line match is excellent and front-to-back ratios are unusually high.

** To provide even greater strength, TRIO Antennas now have stamped steel element clamps.*

TRIO

TRIO MANUFACTURING COMPANY • GRIGGSVILLE, ILLINOIS

At the last regular meeting of the Television Contractors Association, held December 4 at the Penn-Sheraton Hotel, your proposal to license the television service industry in Philadelphia was fully discussed. Attending the meeting, in addition to our membership, were 14 other television service businessmen.

You will perhaps be interested in knowing that at the end of our discussion an informal poll of all attending the meeting was taken on the licensing matter. The result: all agreed that some mechanism, agency, or regulatory body should be established to stabilize the television service industry.

In the poll, these observations were noted:

1. Electronic and television technicians should be licensed.
2. Electronic and television service businessmen (contractors, dealers, and independents) should be registered. They are the employers of the technicians and should assume their proper responsibility in any stabilization program.
3. Every effort should be made to avoid any political use of the program.
4. A nonpolitical examining and licensing board should be appointed to institute and supervise the program within the scope and meaning of the law.

I would like to point out that this is an unofficial expression of this association. Officially, the TCA is on record as being opposed to licensing in any form, and the chief proponent of this thought, our president Albert M. Haas, left the meeting before the aforementioned poll was taken.

However, in a later discussion with Mr. Haas, he informed me that he would naturally abide by the expressed wishes of our association members and the industry in general. He expressed the thought that the poll reflected a feeling in the industry that more desirable methods could not be organized and maintained, and that, apparently, the service segments were turning to outside aid for stabilization of service needs and problems.

Mr. Haas reiterated his belief that licensing is not the answer to the service industry's problems. He hopes, however, that in the event of a licensing law it will be so written and administered as to eliminate any possible shadow of criticism. He further offers his personal assistance as well as the assistance of this association in bringing about a desirable program.

Very truly yours,
PAUL V. FORTE
Executive Secretary

MOCH AGAIN HEADS TISA

Frank Moch was re-elected president of the Television Installation Service Association of Chicago at its annual meeting in December.

Other officers elected were: John Cecish, first vice-president; Sidney Terman, second vice-president; Rudy Saxner, secretary; Gerry Mann, treasurer; and Fred Levine, sergeant-at-arms.

ANNUAL PARTY AT ARTSNY

The annual get-together of the New York City service organization was held at ARTSNY headquarters, 165 East Broadway, on December 14. The affair also marked the first meeting of the newly formed women's auxiliary, which has been in process of organization for the last few months, chiefly through the efforts of the temporary women's auxiliary president, Molly Goldfarb.

Attendance fluctuated during the afternoon, but it is estimated that between 75 and 100 were present at one time or another. Recorded music was supplied for dancing, and there were moving pictures, with appeal aimed chiefly at the children. Sandwiches, beer, coffee, and frankfurters were served and were consumed in quantity. Besides membership, it was noted that representatives were present from radio-TV manufacturers and the technical press.

FRSAP HONORS G-E

The General Electric Co. has received the Pennsylvania Federation's award given annually to the person or organization contributing most to the welfare of the electronic servicing industry during the year.

Install an RCA Weather-Resistant Lightning Arrester and forget it

THE RESISTANCE ELEMENTS in RCA Lightning Arresters are made of a remarkable, new *conductive rubber* that is *noncorrosive and impervious* to moisture . . . to provide *lasting* protection to TV and FM installations. Cap covers contacts. Losses are negligible even under extremely tough weather conditions.

Just mount, unscrew cap, insert transmission line in slot, and replace cap. It's as easy as that. Type 214X1 for indoors, type 215X1 for outdoors. *Both are listed by Underwriter Laboratories, Inc.*

See Your RCA Parts Distributor for "the best lightning arrester to come down the line."

RADIO CORPORATION of AMERICA
ELECTRONIC COMPONENTS **HARRISON, N. J.**

FLORIDA PHILANTHROPY?

The *Bulletin* of the Radio & Television Technicians Guild of Florida, Inc., reports the following as a true incident:

The night before election a Miami service shop received a call to service an RCA projection-type TV receiver. When the technician arrived he found no picture, and cured the trouble by replacing a 6AS7-G and a 6BG6-G. The list price of the tubes alone was $11.80, without the sales tax and service charge.

The day after election the set owner called the shop and accused them of being thieves. It seems he had read an ad that said "Any set repaired in your house for under $8." The *Bulletin* (and we, too) would like to know how the generous advertiser would have handled this job.

ARTSNY HAS NEW IDEA

A new method of organization of TV-radio service associations has been introduced by the Associated Radio-Television Servicemen of New York (City). Noting that in the past some associations have become inactive because of diversity of interests among the members, and that the same cause has resulted in a multiplicity of associations in some cities, ARTSNY has been reorganized to take account of that diversity of interest among its various members.

The new association is composed of two sections: *business* and *technical*, each with its chairman, complete staff of officers and board of directors. There is a president and treasurer for the whole organization, and the chairmen of the two sections are vice-presidents of the association. The president will be elected for one term alternately from the business and technical sections. Business meetings are held on the second and fourth Thursdays of each month, and technical meetings on the first and third. All members owning businesses are enrolled in the business section. If, in addition, they qualify as technicians, they are also members of the technical section and are entitled to vote in both the business and technical sections.

Officers of ARTSNY for 1953 are:
Association president: Max Leibowitz.
Association treasurer: Sid Perlin.

Business section: Chairman and vice-president, Phil Goldfarb; corresponding secretary, Arthur Rhine; recording secretary, Jerry Maccherone; financial secretary, Jack Lacey; business director, Jack Ornstein; Sergeant-at-Arms, Lou Gioia.

Technical section: Chairman and vice-president, O. Capitelli; corresponding secretary, Harold Levinson; recording secretary, Jacob Allen; financial secretary, Joe Guarnieri; technical director, Lou Bentz; Sergeant-at-Arms, Sid Cornfield.

The two groups of officers, together with the five-man boards of directors of each section, constitute the executive body of the organization, and meet once a month. END

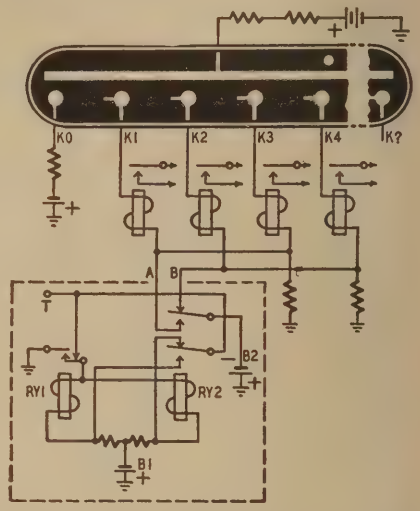
MULTICATHODE GLOW TUBE

Patent No. 2,608,674

Wallace A. Depp, Mountainside, N.J.
(Assigned to Bell Telephone Laboratories, Inc.)

Multicathode glow lamps can simplify the design of pulse counters. This counter uses a tube with specially-shaped cathodes. Each has a spherical surface and a point as shown. The point of one cathode faces the rounded portion of the next. Only 5 cathodes are drawn in the figure, but 10 are needed in a decade counter. One anode serves for the entire tube. It is connected to a positive voltage high enough to sustain one cathode glow.

K0 is the *reset* cathode on which the glow normally rests. The even-numbered cathodes are fed by conductor B, the odd-numbered ones by A. These leads are driven negative alternately by the pulses to be counted.



The first pulse drives A negative. Therefore the glow is transferred from K0 to K1, the more negative cathode. The second pulse drives B negative and the glow moves on to K2, the nearest cathode with a large negative potential. The next pulse makes A negative again. Now both K1 and K3 are more negative than K2, so the glow will be transferred to one of them. Actually, K3 receives the glow, for the following reason: On each cathode, electrons distribute themselves uniformly on a rounded surface, but they concentrate at the *point*. Ionization is most intense here. Thus the discharge is always drawn from a glowing cathode to an adjacent *point* biased negatively.

The actual count is indicated by the relays in the cathode circuits.

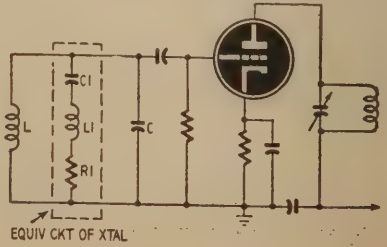
The cathode-control voltage is applied by the relay unit (shown within dashed lines). This is energized by pulses at T. When T is grounded by a pulse, B1 energizes relay RY1. Its armature is drawn down. This grounds and energizes RY2. Negative voltage from B2 (through the upper armature of RY2) appears on conductor A. The voltage on B is zero because of its grounded resistor. The next time T is grounded, both terminals of RY1 are shorted (to ground) so it releases its armature. This disconnects ground from RY2, which also releases. Now B2 feeds its negative voltage to B. Voltage on A returns to zero.

CRYSTAL OVERTONE CIRCUIT

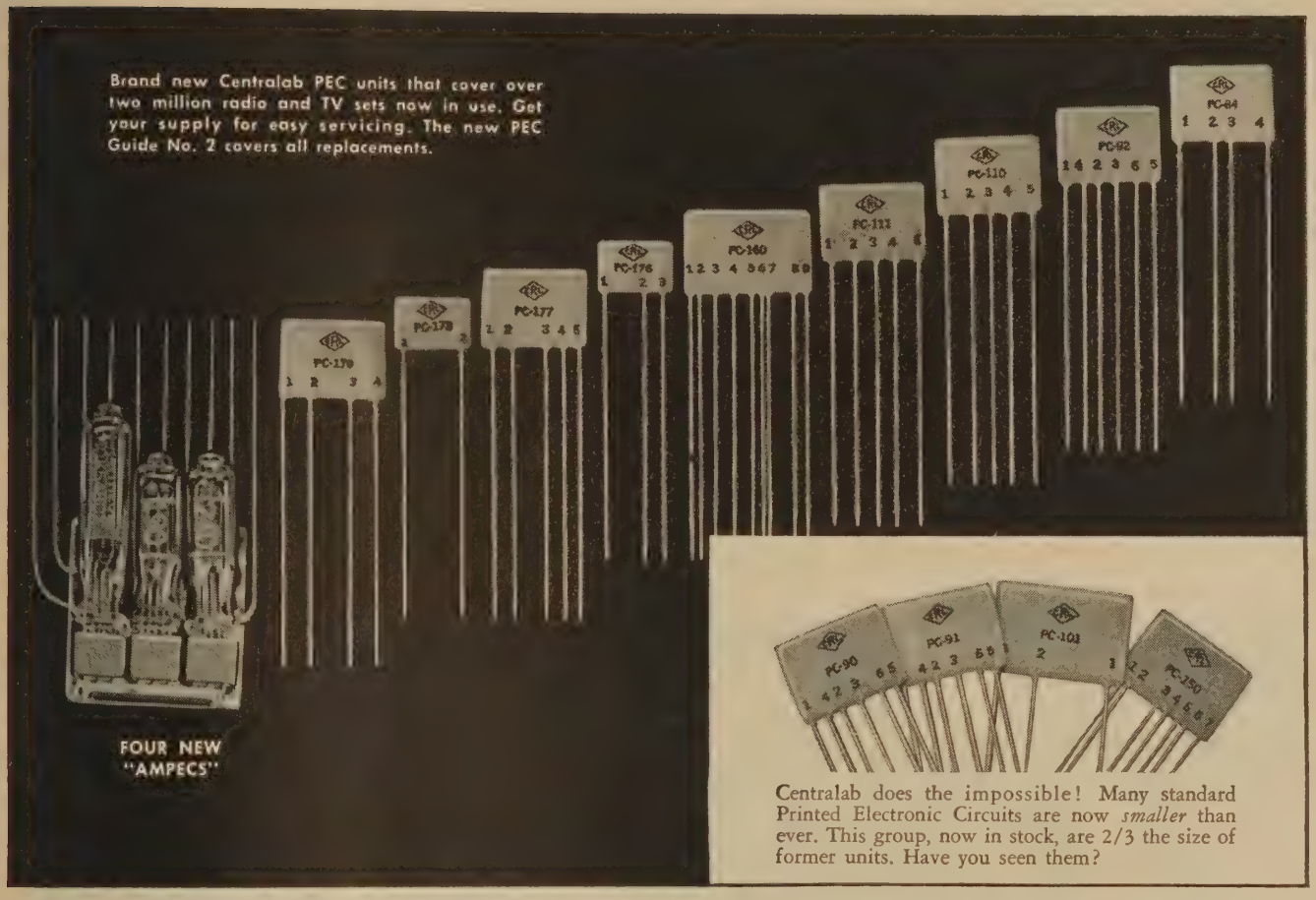
Patent No. 2,613,320

Albert R. Panetta, Cleveland, Ohio
(Assigned to Electronic Research and Manufacturing Co.)

A piezo-electric crystal may be operated at an overtone frequency when a coil is shunted across



Thirteen NEW CRL Printed Electronic Circuits for replacement service!



Centralab does the impossible! Many standard Printed Electronic Circuits are now *smaller* than ever. This group, now in stock, are 2/3 the size of former units. Have you seen them?

Now Available from your Centralab Distributor

THESE thirteen new Printed Electronic Circuits are now in use in thousands of radio and TV sets. You should have a complete stock on hand for shop work and service calls. Centralab Circuits are safest and easiest for servicing. In most cases, the replacement PC number is the same as shown on the original part.

These new PEC units replace whole Pentode Coupling, TV I. F., Triode Coupling, or Pentode Detector networks. Four new plates, too, to replace *special* manufacturer's parts. Together with the other CRL stock Printed Electronic Circuits, these parts will cover 95% of all PEC replacements. Over 15 million circuits are now in use . . . are you ready to service them?

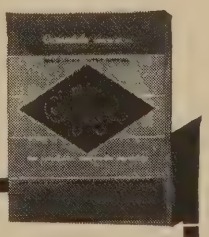
Don't overlook the new smaller sizes in older PEC units. Small size is not enough . . . Centralab makes Printed Electronic Circuits even smaller! For complete information on parts, replacements, and test data, see the *new* Printed Electronic Circuit Guide No. 2. Ask your distributor for a copy, or use the coupon.

Make your Centralab distributor headquarters for exact electronic replacements

Centralab

A Division of Globe-Union Inc.
Milwaukee 1, Wisconsin
In Canada, 635 Queen Street East, Toronto, Ontario

Centralab Printed Electronic Circuits are among the more than 470 *new* items listed in Centralab's new Catalog 28. Get your copy of this 32-page index to the latest developments in the fast-changing electronic field, plus the 20 page Printed Electronic Circuit Guide No. 2. See your distributor or use coupon.



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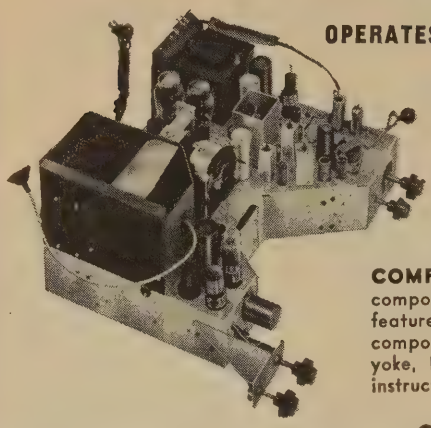
Please send me my copy of:
☐ P.E.C. Guide No. 2 ☐ Centralab Catalog 28

Name.....Position.....
Company.....
Address.....
City.....State.....

#630 SUPER DELUXE 31-TUBE TV KIT



OPERATES ALL 16" TO 24" PICTURE TUBES

Engineered in strict adherence to the genuine RCA #630, plus added features ★ ★ ★ ★ ★

NOTHING BETTER AT ANY PRICE!

- Standard Cascode Turret Tuner for DX
- Cosine 70° Deflection Yoke for Definition
- Original 630 Synch. Chain for Stability
- 16 KV for Clarity and Brilliance
- Fast Action Pulse Keyed AGC
- Large Concert-tone 12" PM Speaker

COMPLETE SET OF PARTS including the basic components of the STANDARD KIT plus added features, more tubes, doubler components, AGC components, Cascode tuner, Cosine 70° deflection yoke, 12" speaker, etc., and the Brooks LIFE-SIZE instructions (less CRT & wire)

only . . . **$119.44**

#630 STANDARD TV KIT

THIS OFFER MAKES TV HISTORY . . . never ever so low a price, never ever such high quality . . . Quality and improvements in components that will enable the finished chassis to operate 10", 12½" and certain 16" picture tubes . . . This STANDARD KIT consists of a complete set of parts, similar to those used in the famous RCA #630 29-tube chassis, including all tubes, speaker, resistors in correct 5%, 10%, 20% tolerances, the new Cascode Tuner and the Brooks LIFE-SIZE Instructions (less CRT & wire)

only . . . **$93.78**

STANDARD PICTURE TUBES

BRAND NEW —— With a Full Year Guarantee

10"	— #10BP4A	(Round, Black)	$18.36
12½"	— 12LP4A	(Round, Black)	24.72
14"	— 14CP4A	(Rectangular, Black)	26.48
16"	— 16AP4A	(Round, Metal, Black)	28.97
16"	— 16DP4A	(Round, Black)	28.97
16"	— 16GP4A	(Round, Metal, Black)	28.97
16"	— 16TP4	(Rectangular, Black)	28.97
17"	— 17BP4A	(Rectangular, Black)	29.63
19"	— 19AP4A	(Round, Metal, Black)	39.82
20"	— 20CP4	(Rectangular, Black)	39.74
21"	— 21EP4A	(Rectangular, Black)	44.68
24"	— 24AP4	(Round, Metal, Black)	79.49

#630 SUPER DELUXE 31-TUBE TV CHASSIS—KNOWN MFR.—

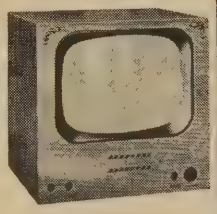
Licensed under RCA patents

COMPLETE READY TO PLAY including all tubes and CRT mounting brackets. No charges for extras of any kind. Each set is factory aligned and air tested. All parts are guaranteed 3 months. Our booklet "HINTS FOR BETTER PERFORMANCE ON YOUR #630 TV RECEIVER" is supplied with each set. —— Your best buy at ..... **$167.97** (less C.R. Tube)

CUSTOM-BUILT CABINETS FOR #630 AND ALL OTHER TV SETS — FROM FACTORY TO YOU

5 LEADING STYLES in genuine mahogany or walnut (blond 10% extra). Ready drilled for any #630 TV chassis and cutout for any 10" to 21" picture tube at no extras in price. Also supplied with undrilled knob panel for any other TV set. EVERYTHING NECESSARY for an easy perfect assembly is included. Each cabinet is delivered complete as pictured with mask, safety glass, mounting brackets, backboard, backcup, hardware and assembling instructions. Each cabinet is shipped in an air cushioned carton from FACTORY to YOU.

The VOGUE
Most Popular Table Model.



H-24", W-26", D-23"

$39.89

VOGUE also available for 24" or 27" picture tube
H-31", W-27", D-23"

$62.54

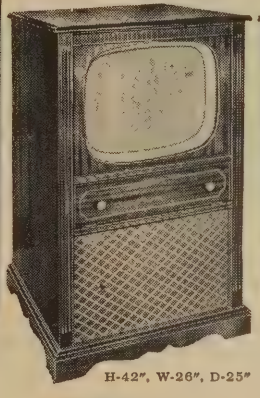
The MANHATTAN
Style, Quality, Price

H-41", W-25", D-23"

$59.37

MANHATTAN for 24" or 27" CRT
H-46½", W-27¾", D-24" **$86.22**

The STREAMLINER
Center Drop Panel Conceals Tuning Knobs.



H-42", W-26", D-25"

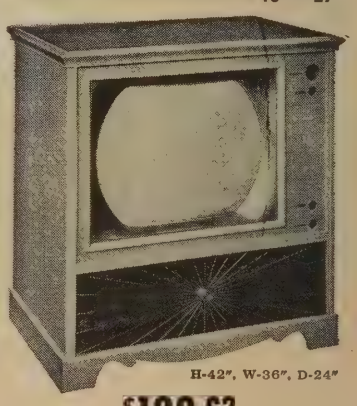
$74.98

The NEW YORKER
A Deluxe Cabinet With a Piano Finish.

H-42", W-26", D-24"

$96.87

The TOWN & COUNTRY
Patterned after the popular credenza.
Available for all size picture tubes 10" to 27"



H-42", W-36", D-24"

$109.62

RADIO & TV HINTS

By the publishers of RADIO-ELECTRONICS

The latest Gernsback Library Book! Crammed from cover to cover with over 300 tricks of the trade compiled from the experiences of men in the business. Shows you the fastest and easiest way to get tough jobs done. A valuable tool for your work bench. Postpaid only $1.00

- Hints for Better Pictures on 630TV
- 630TV Diagram with Modifications
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- Pulse Keyed AGC Circuit Diagram
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All for only **$1.00** Postpaid

RADIO SERVICING COURSE

This book is your practical radio course of 22 easy-to-follow lessons. Review fundamentals, learn new servicing tricks, all about signal tracing, oscilloscopes, recording, P.A., test equipment, and TV. Just like a $100.00 correspondence course. Everything in radio servicing. Postpaid only $2.50

THE NEW CASCODE TUNER

can now be installed in *ANY* TV set with the

Brooks **CASCODE MANUAL**

Illustrations, Schematics and easy to follow, step by step Instructions

only **50¢** Postpaid

Modernize a #630 or any TV Set With a New STANDARD CASCODE TUNER

For better all around performance

Complete with tubes, incl. step by step instruction Cascode Manual **$22.49**

Brooks LIFE-SIZE *Edition*

#630 TV KIT BUILDER—SET OF INSTRUCTIONS

BUILDING YOUR OWN #630 TV CHASSIS is now simplified with this **COMPLETE SET OF BUILDING & WIRING INSTRUCTIONS.** Covers all #630's, from the RCA 10" SET to the latest SUPER DE LUXE 31-tube 16" to 24" RECEIVER.

EVERYTHING AT A GLANCE-LAYOUT CHARTS show chassis and components in actual **LIFE-SIZE** with instructions alongside the illustrations.

GUESSWORK IS ELIMINATED by specially prepared SCHEMATIC DIAGRAMS, LOCATION GUIDANCE, CODE CHARTS, ALIGNMENT PROCEDURE and TOP AND BOTTOM PHOTOGRAPHS OF A COMPLETED CHASSIS (assembled from these instructions) clearly showing placement of each component.

Popular priced at only.....**$2.49** Postpaid

BROOKS RADIO & TV CORP., 84 Vesey St., Dept. A, New York 7, N. Y.

TELEPHONE COrtland 7-2359

it. The coil cancels out *most* but not all of the shunt capacitance across the crystal (due to the crystal holder and circuit wiring).

The circuit shows a conventional crystal circuit. L is the coil to be added. L1, C1, and R1 are equivalent values of the crystal itself. C is the shunt capacitance. At overtone frequencies, L1 and C1 are effectively smaller, but C is unchanged. The low reactance of C shunts the crystal and damps out oscillations. In this patent, L is added in shunt to reduce the effect of C across the crystal. For example, at the ninth overtone, the shunt capacitance C should be about one-ninth its value at the fundamental. L accomplishes this reduction by balancing out the effect of C.

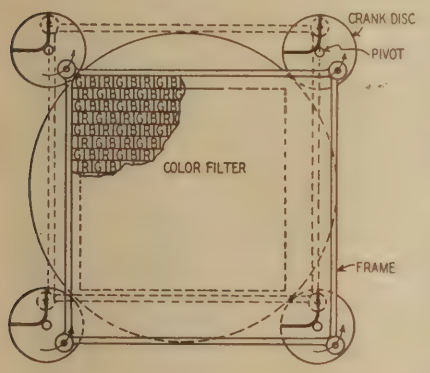
COLOR TV

Patent No. 2,617,875

Lee de Forest, Los Angeles, Calif.

(Assigned to Allen B. Du Mont Laboratories, Inc.)

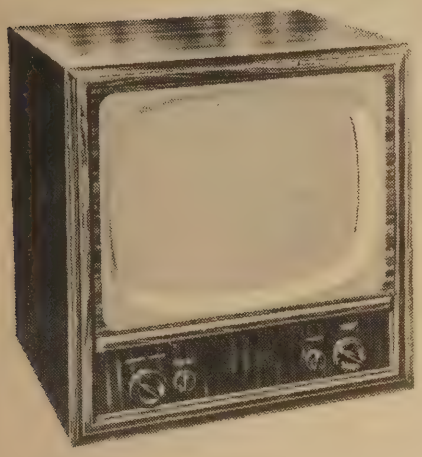
The "Father of Radio" devised this new TV system which eliminates the large rotating color wheel. Instead, it uses a filter composed of the small colored squares, triangles, or hexagons. The letters R, G and B in the figure refer to red, green and blue segments of which the new color filter is composed.



A color wheel must be at least twice as large as the kinescope face since each sector must completely cover the kinescope in turn. The new filter need be only slightly larger than the picture tube because its color elements are so small. Merely a slight circular motion of the filter is sufficient to present all three primary colors successively in front of each small picture area on the screen.

The frame which holds the filter is guided and moved by four crank discs. They move the filter in a small circular orbit. During each cycle the primary colors are changed successively to give the illusion of true color. This filter must be constructed exactly like the one used at the transmitter. Furthermore, both the transmitting and receiving filters must be moved in synchronism along identical paths. END

TeleSound CUSTOM TV RECEIVERS



COMPLETELY ASSEMBLED Super Deluxe DX-TV Chassis in TELESOUND CABINET

with Picture Tube and Speaker—Ready to Operate!

An Outstanding Line of Fine TV Receivers at Amazingly Low Prices!

Famous Make Super Deluxe DX Chassis features Sensationally new Cascode Tuner ESPECIALLY ADAPTED FOR FRINGE AREA RECEPTION! Gracefully proportioned, smartly styled ribbon stripe mahogany veneer cabinets, with gold picture tube frame.

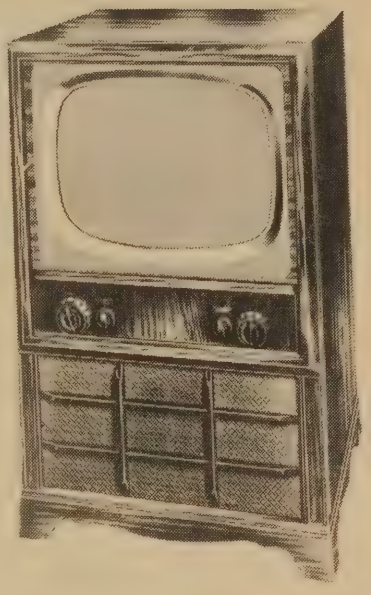


TABLE MODELS

Model T-17 With 17" Picture Tube, Cabinet size: 18" H, 20½" W, 19¼" D. Your Net Cost.....**$169.50**
Model T-20 With 20" Picture Tube, Cabinet Size: 24" H, 24" W, 22" D. Your Net Cost.....**$179.50**
Model T-21 With 21" Picture Tube, Cabinet Size: 24" H, 24" W, 22" D. Your Net Cost.....**$184.50**

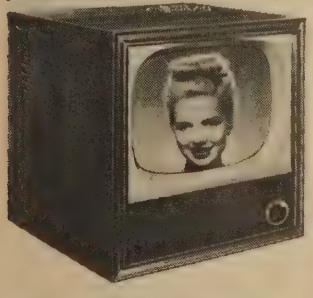
CONSOLE MODELS

Model C-17 With 17" Picture Tube, Cabinet Size: 37½" H, 22" W, 19½" D. Your Net Cost.....**$189.50**
Model C-20 With 20" Picture Tube, Cabinet Size: 40" H, 24½" W, 22½" D. Your Net Cost.....**$199.50**
Model C-21 With 21" Picture Tube, Cabinet Size: 40" H, 24½" W, 22½" D. Your Net Cost.....**$204.50**

TeleSound CUSTOM-BUILT TV CABINETS

DIRECT FROM MANUFACTURER TO YOU—*COMPARE PRICE and QUALITY!*

Be price conscious! TELESOUND Wholesale Prices enable you to sell more, make a BETTER PROFIT for yourself!



H:25", D:21½", W:25" Wgt: 50 Lbs.
TABLE MODEL 500 ..... **$42.00**

As above, for 24" Picture Tube H:31", D:24", W:27" Wgt: 60 lbs. **$55.80**

H:40¼", D:22½", W:25¼" Wgt: 60 lbs.
CONSOLE MODEL 200 ..... **$47.50**

ALL PRICES TAX INCLUDED

H:40½", D:24", W: 25", Wgt: 100 lbs.
CONSOLE MODEL 800
$82.50

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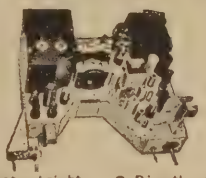

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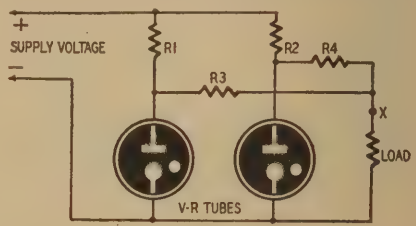
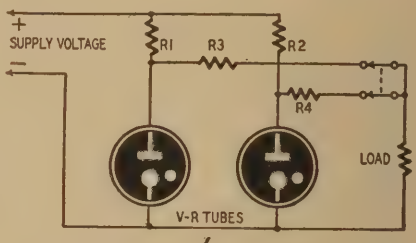
V-R TUBES IN PARALLEL

In most instances, it is impractical to connect two voltage-regulator tubes in parallel to stabilize a voltage at a current rating higher than that of a single tube. The reason is that no two V-R tubes have exactly the same striking voltage. So, when the voltage is applied, it rises until one tube fires. The conducting tube pulls down the voltage and prevents the paralleled tube from firing. The conducting tube will soon fail in service because it is carrying excessive current.



a



b

A solution to the problem of operating voltage-regulator tubes in parallel is described in *Radio Constructor* (London, England). The circuit at *a* is used for comparatively light loads. R1 and R2 (equal values) are the usual series-dropping resistors. R3 and R4 are relatively large resistors between the V-R tubes and the load. When the first tube fires, the voltage on the remaining tube is high enough to fire it. The voltage applied to the second tube is determined by the values of the resistors and the load current. If the load is moderate, the second tube fires and both pass substantially equal currents. If the load current is too high, the second tube will not fire. In this case, a switch may be inserted at X. The switch should not be closed until both tubes have fired.

If the load current is high enough to produce an excessive voltage drop across R3 and R4, use the circuit at *b*. In this circuit, R3 and R4 may be 100 ohms or less. The load is disconnected from the regulators until both tubes fire, then the switch is closed.

BEGINNER'S CODE OSCILLATOR

The a.c.-d.c. code practice oscillator shown in the diagram is designed to be constructed and used by beginners who have had only a brief acquaintance with radio. For this reason, the circuit and method of construction were selected to minimize shock hazard and reduce the cost.

The circuit uses a 12A6-GT oscillator and a 35Z5 rectifier. T1 and T2 are small, inexpensive a.f. output transformers. T1 is the feedback transformer. Its secondary is in series with the

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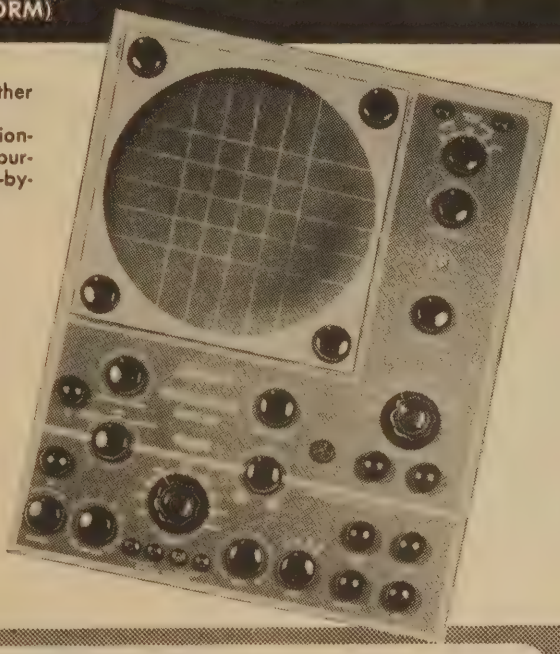

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*Model 630KA $38.95 (pre-assembled head)
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Model 630K **$33.95**

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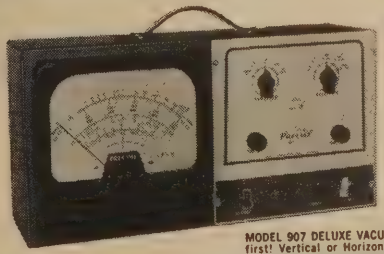

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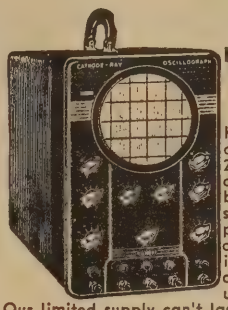

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1U5	.48	6BG6	1.21	6SQ7	.42	12AZ7	.94	25BQ6	.77
1S5	.48	6BH6	.62	6T8	.74	12BA6	.47	25W4	.48
1X2	.63	6BJ6	.53	6U6	.57	12SA7	.52	25L6	.48
5U4	.38	6BK7	.86	6U8	.78	12SK7	.49	25Z6	.42
5W4GT	.46	6BQ6	.76	6V6GT	.46	12SL7	.57	35L6	.48
5Y3GT	.29	6BQ7	.86	6V8	.83	12SN7	.54	35Z5	.33
6A7	.62	6CB6	.48	6W4	.45	12SQ7	.42	50L6	.48
6A8	.51	6F6	.49	6W6	.52			80	.38
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6AK5	1.14	6L6G	.89	7C6	.42				
6AL5	.41	6SA7	.52	7X7	.62				
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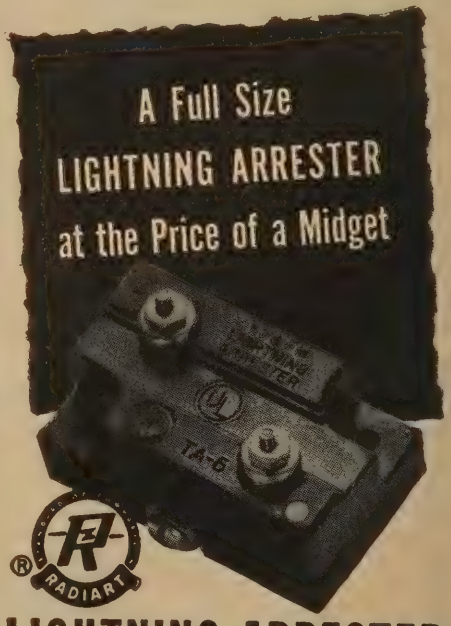

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MODEL TA5 Real protection against lightning and static charges — the RADIART Lightning Arrester has all the features! Fits anywhere... inside or out... handles standard or jumbo leads... no wire stripping necessary... does not unbalance the line... low internal capacity... no loss of signal ...internal resistance "leaks off" static discharges! UNDERWRITERS LABORATORIES APPROVED.

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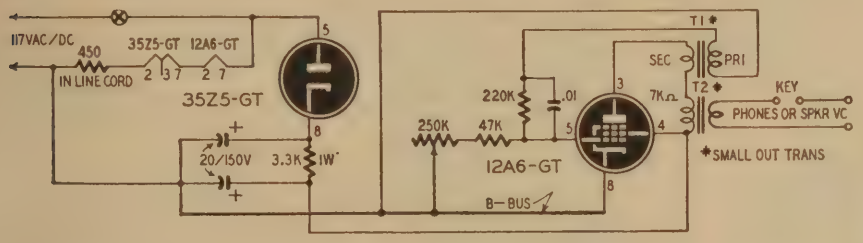
plate circuit; its primary supplies the grid with the positive feedback voltage necessary for sustained oscillations. If the circuit does not oscillate when first hooked up, reverse the connections to one of the windings on T1.



T2 has its primary in series with the plate lead of the 12A6-GT. Its secondary feeds the key and phones or speaker voice coil connected in series across it. A speaker is recommended when the unit is used for several students or for classroom work.

The unit was built on a masonite and plywood chassis with T1 and T2 mounted underneath. When construction was finished the chassis was closed with a bottom plate. The only components on the outside of the chassis that an operator can touch are two glass tubes, the key, and phone pin jacks. The key and phone jacks are isolated from B plus and ground, so you cannot get a shock from them. A glass type 12A6 was chosen because a metal one with its grounded shell would present shock danger above the chassis.

All B minus leads are brought to a tie lug conveniently located between the 35Z5 and 12A6-GT. The grounding lugs built around the octal sockets are not grounded. If they were, the bolt heads above the chassis would be a source of shock hazard. It is also for this reason the shells of the transformers are not grounded. A line cord resistor was chosen to keep heat out of the closed chassis.—*B. W. Welz*

NEW PHASE-SHIFT OSCILLATOR WITH WIDE FREQUENCY RANGE

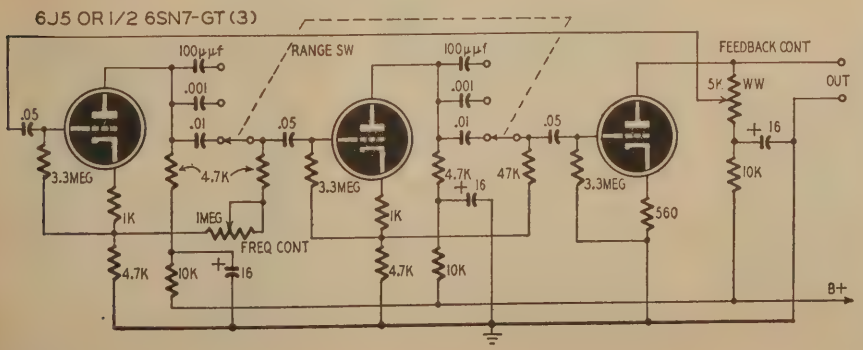
We often read an interesting paper on the theoretical development of some device which seems to have many advantages and uses. But—the article lacks sufficient information to permit the device to be developed without a lot of cut-and-try and experimentation, or the author has obviously omitted the one bit of data upon which the success of the device depends.

The November, 1950, issue of *Wireless World* (London, England) carried an interesting discussion of a new type of phase-shift oscillator which requires only one variable element to cover a tuning range of 10 to 1. We made notes on the circuit and design data and planned to develop the circuit independently at our earliest convenience. But, we never got around to it.

A New Zealand experimenter saved us the trouble by reducing the circuit to practice and describing it in *Radio and Electronics*. The oscillator circuit is shown in the diagram. The unit tunes from 15 to 15,000 cycles in three ranges. The 1-megohm variable resistor is the tuning control. Ranges are changed by switching in different capacitor values between the first and second and second and third stages. The 5,000-ohm potentiometer is the feedback control. For low-distortion output, it should be adjusted to the lowest possible setting which provides reliable oscillation on all ranges.

After describing the circuit in the diagram, our New Zealand friend suggests that it is theoretically possible to increase the frequency ratio of each range to 100 to 1 by replacing the 47,000-ohm resistor between the second and third stages with a 1-megohm potentiometer ganged to the first. A range of 1,000 to 1 may be obtained by using three phase-shift stages with ganged variable resistors in each feedback network.

I could use an audio signal generator which has a frequency ratio of 1,000 to 1 in a single range. Gotta get busy on this circuit and see how it works out. If you should get the answer before you hear from me, drop me a line in care of RADIO-ELECTRONICS. I probably won't get around to doing any work on it for several years.—*Henry O. Maxwell*



TESTER-REACTIVATOR UNIT

Transvision, Inc., New Rochelle, N. Y., has released a new C-R tube tester-reactivator-sparker. The instrument measures cathode emission, reactivates dim, worn-out tubes, and sparks out electrical leakage. It weighs 6 pounds, and plugs into any 110-volt receptacle.

MOBILE AMPLIFIER

Bell Sound Systems, Inc., 555 Marion Rd., Columbus 7, Ohio, is manufacturing a phono-top portable amplifier, the model 3723M-B.

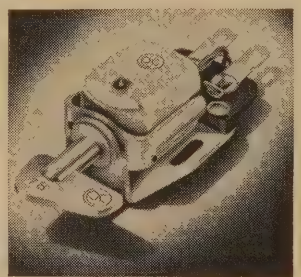
The unit has a bifilar-wound power transformer, allowing the use of four sets of vibrator contacts. The two microphone inputs and the built-in phono have separate volume controls so that intermixing of the inputs can be controlled at any desired level.

Other features are tone control, off-on switch, phono-motor switch, and a stand-by switch which supplies power for the tube heaters and bias but cuts off the rest of the system to conserve battery during intermittent use.

The unit operates on 117 volts, 60 cycles a.c. or on 6 volts d.c., and delivers 25 watts audio output with a peak of 38 watts. The amplifier is available with a single- or triple-speed turntable.

TURN-OVER PICKUP

Pickering & Co., Oceanside, N. Y., has announced a new turnover pickup to play 33⅓-, 45-, and 78-r.p.m. records. The model 260 has an output of 30 millivolts at 10 centimeters per second and mounts in any type arm. It is available with diamond styli.

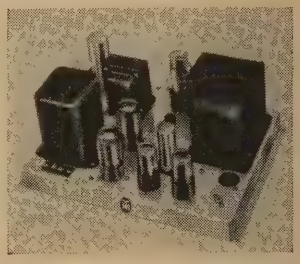


AMPLIFIER AND PREAMP KITS

Tech-master Products Co., 443 Broadway, New York 13, N. Y., has entered the high-fidelity audio equipment field with four new amplifier kits. The TM-15A and TMD-15A are ultra-linear versions of the Williamson amplifier. Undistorted power output is 15 watts into 4-, 8-, or 16-ohm loads. Using 20 db feedback, response is 8 to 80,000 cycles ± 1 db at 5 watts and 12 to 56,000 cycles ± 1 db at 10 watts. Intermodulation and harmonic distortion: 0.25% at 2 watts and 0.45% at 5 watts. The kits feature specially wound Peerless output transformers. Tube complement: two 6SN7-GT, two 5881, and one 5V4-G. Power input: 120 watts, 105–125 volts, 60 cycles. Dimensions 9 x 12 x 6½ inches.

The TM-15P and TMD-15P preamplifier kits have one low-level, high-gain input channel and three high-impedance channels. Bass frequency control provides 15 db of boost or cut at 20 cycles and the treble control provides 15 db of boost or cut at 20 kc. The 3-position equalization control selects 300- or 500-cycle turnover without rolloff for 78's, and a 400-cycle turnover with 12 db rolloff at 10 kc for 33⅓- and 45-rpm recordings. Tube complement: One 12AX7 and one 12AU7. Power requirements: 125 volts d.c. at 6 ma and 6.3 volts at 600 ma. Dimensions: 10¾ x 4 x 4 inches.

The TM series kits are supplied with punched chassis, transformers, tubes, and all other components. The TMD series are de luxe factory-assembled kits, ready for wiring.



TRANSFORMERS

Ram Electronics Sales Co., S. Buckhout St., Irvington-on-Hudson, N. Y., has announced two horizontal output transformers. The model X071 is an exact replacement for Admiral parts No. 79C30-1 and 79C30-3, and model X072 is an exact replacement for Admiral part No. 79C30-4. The transformers are designed and constructed to the specifications of the set manufacturer.

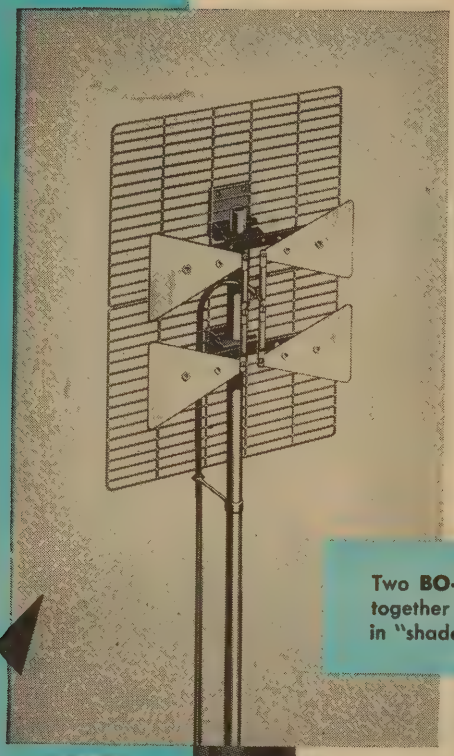
Both models are engineered for 66–70 degree horizontal deflection angle, use a ferrite "E" core, and deliver up to 15 kv.

1-CHANNEL BOOSTER

Channel Master Corp., Ellenville, N. Y., has announced production of a new single-channel booster, the *Katy-B*. This booster uses the 6BQ7 low-noise tube in a cascode circuit. It has a gain of 22 db on the low band and 18.6 db on the high band. Noise figure is 4.5 db on the low band and 6.5 db on the high band.

The unit has double-tuned transformers wound for each channel, and an antenna bypass switch which permits it to pass signals of other channels without loss or interference. It provides for both 72- and 300-ohm input and output. The booster mounts behind the TV set.

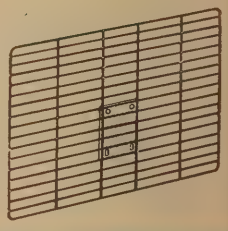
...and now UHF antennas by AMPHENOL



The magic words in television these days are Ultra High Frequency. That UHF television is a practical reality has been proved, not only by laboratory tests, but also by the success of the first commercial UHF station now operating in Portland, Oregon. Because of the high signal losses common to UHF, it is extremely important that the entire antenna system be of the finest quality and of a proved design. The choice of antenna and the availability of the proper accessories to adapt that antenna to the particular locale are factors that determine the success of any UHF installation. The entire Amphenol line of UHF antennas and accessories has been designed and approved by the Amphenol team of engineers that achieved industry-wide renown for the origination of the Inline VHF Antenna.

The BO-TY UHF Antenna is the first of a complete line of Amphenol UHF antennas. It is designed as a general purpose UHF antenna for all major signal areas. The Amphenol UHF Antennas previewed for you at the left have been designed to answer the varied installation requirements in major, fringe or "shadow" areas.

Two **BO-TY 114-053** Antennas with Reflectors, **114-560,** stacked together with Stacking Rods, **114-558,** for increased signal strength in "shadow" areas or nearby fringe.



Model 114-053 *BO-TY Antenna is a bi-directional, all-channel UHF antenna. It is fastened to the mast with an integral universal clamp that accommodates masts from ¾" to 1½" O.D.*

Model 114-558 *Stacking Rods are designed for stacking BO-TY antennas one above the other. Stacking BO-TY antennas provides additional gain and the Stacking Rods maintain perfect impedance match.*

Model 114-560 *Reflector is designed for the BO-TY Antenna when a uni-directional pattern is desired. Addition of the 114-560 also helps somewhat in increasing the gain of the BO-TY.*

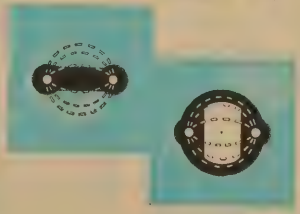
Model 114-054 Yagi UHF Antenna for high gain on specific channels

Model 114-057 "V" combination UHF and VHF Antenna

Model 114-058 All-Channel UHF Corner Reflector Antenna

Model 114-060 UHF Rhombic Antenna for high gain and rejection of reflected signals

These UHF antennas are currently in final laboratory tests and will shortly be released to production. When available they will meet the mechanical and electrical efficiency characteristic of all Amphenol antennas.



AMPHENOL Tubular TWIN-LEAD

Amphenol Tubular Twin-Lead has proved itself to be the best answer to the need for an economical lead-in for UHF television. Actual installations in Portland, Oregon have established the superiority of Tubular over all other existing types of twin-lead.

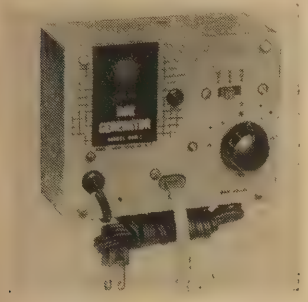
The tubular construction provides a constant impedance that is virtually unaffected by age, weather conditions, salt or dirt deposits on the line. The extremely low-loss of the Tubular Twin-Lead is one of the characteristics that is essential to a UHF lead-in.

The illustration at extreme left reveals the lack of protection that the dielectric of flat lead-in affords to the essential field of energy between the conductors in twin-lead. The illustration to the right demonstrates how this field of energy is protected within the tubular twin-lead and therefore is unaffected by external weather conditions or deposits on the line.

AMPHENOL

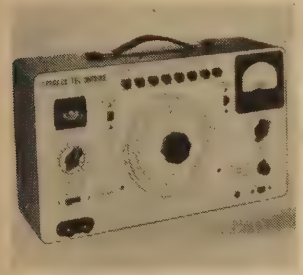
BAR GENERATOR

RMS, 2016 Bronxdale Ave., New York 60, N. Y., has introduced a portable bar generator, model BAR-1. The instrument transmits a modulated carrier on channels 4, 5, or 6, producing both vertical and horizontal bars on the screen. The number of bars may be adjusted by a control. By adjusting linearity controls and size controls, accurate linearity can be obtained even when the station is not on the air.



NEW ANALYZER

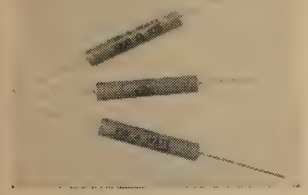
Sprague Products Co., 81 Marshall St., North Adams, Mass., has announced a capacitor-resistor analyzer, the model TO-4 *Tel-Ohmike*. The unit has capacitance ranges from 1 μμf to 20,000 μf, with special low range for small ceramic and molded "gimmick" capacitors, direct reading of insulation resistance to 20,000 megohms, direct leakage current readings of electrolytic capacitors at rated d.c. working voltage, and a 3-range power factor measurement.



Capacitors are automatically discharged after testing by releasing range-selector push-button. An electron-ray tube is used to simplify Wien bridge balance on capacitance and resistance measurements. Resistance range is from 2.5 ohms to 25 megohms.

FOUR-WATT RESISTOR

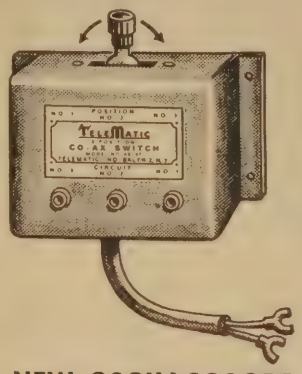
International Resistance Co., 401 N. Broad St., Philadelphia 8, Pa., has added a 4-watt power resistor, type PW4, to its line. The unit is insulated; wire element is wound on a glass fiber core, and axial leads are 1½ inches long and .036 inch in diameter. The body dimensions are 1¾ inches long by 21/64 inch diameter. Type PW4 is available from 1 ohm to 8,200 ohms in ± 5% and ± 10% tolerance.



NEW SWITCHES

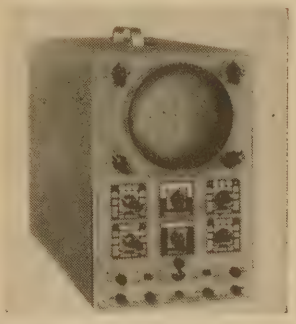
Tele-Matic Industries, Inc., 1 Joralemon St., Brooklyn, N. Y., has announced the addition of several new switches to its line.

Model AS-46 is a 2-position antenna switch in a shielded metal container. AS-47 is a low-loss 3-position coaxial switch for antenna selection for 72-ohm line that can also be used for phonograph, audio, and microphone selection. The AS-48 is a 2-position coaxial slide switch for antenna, phonograph, microphone, and general purposes. The AS-49 is a 4-position low-loss switch for antenna selection.



NEW OSCILLOSCOPE

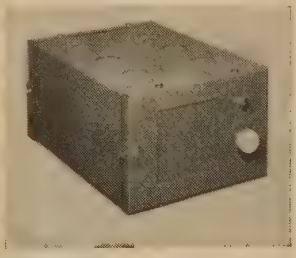
Electronics Measurements Corp., 280 Lafayette St., New York, N. Y., has announced its model 600 scope, which uses a 5VP1 5-inch C-R tube. The vertical amplifier has wideband width and can be used up to 5 mc. A two-step attentuator input is available.



Synchronization is available on either positive or negative input. A multivibrator type of sweep from 15 cycles to 75 kc is incorporated.

MOBILE RECEIVER

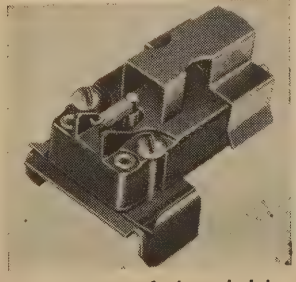
Radio Apparatus Corp., 55 N. New Jersey St., Indianapolis 4, Ind., has announced a mobile 6-volt v.h.f. AM radio receiver for radio paging systems. The *Monitoradio*, model AMC-1, is designed for cars as a supplement to the pocket receivers used by most paging systems.



PLASTIC CARTRIDGE

Webster Electric Co., 1900 Clark St., Racine, Wis., has announced its model BX replacement cartridges for RCA automatic record changers and Columbia record players.

The plastic cartridge tracks at 45 or 33⅓ r.p.m. It can be installed in any standard ½-inch mounting arm. Mounting bracket, spacers, nuts, and screws are furnished. The BX has a 1-mil osmium-tipped needle. END

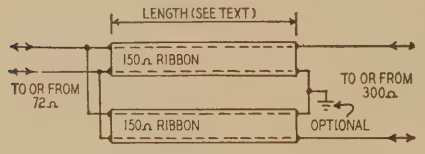


All specifications given on these pages are from manufacturers' data.

IMPEDANCE-MATCHING STUBS

? *I have been using a section of 150-ohm transmission line between a 72-ohm antenna and a 300-ohm transmission line. I have been told that a bazooka-type matching section is more efficient. Can you tell me how to construct such a device?—N. J. S., Columbus, Ga.*

A. You are probably referring to the arrangement shown in the diagram. It can be used to match a 72-ohm antenna or receiver to a 300-ohm transmission line, or a 72-ohm line to a 300-ohm receiver or antenna. A ground may be connected as shown in the figure. It will minimize noise pickup and protect the system against lightning strokes.



The matching section is most efficient at a frequency at which it is one-quarter wavelength long. If you are using a single-channel antenna, make the section one-quarter wavelength long at the center of that channel. To find the length in inches, divide 2,380 by the frequency in megacycles. Matching sections for all-channel, low-band, and high-band antennas are 27 inches, 39½ inches, and 14½ inches long, respectively.

WILLIAMSON OUTPUT

? *I have not been able to locate the output transformer recommended for the Williamson amplifier described in the July issue. I have heard that I can use any transformer as long as the impedances are correct. Can you recommend a suitable transformer made by Hammond, or how can I get the unit I need, here in Canada?—A. M. C., Kenogami, P. Q., Canada.*

A. The Williamson requires a transformer wound to much more exacting specifications than the average output transformer. The primary and leakage inductances must be held to close limits. If you want optimum performance from the amplifier, we strongly recommend that you get a transformer designed especially for it. We do not know whether or not Hammond is making a transformer for this amplifier. You might drop a line direct to the company and find out.

Transformers for this amplifier are made by a number of manufacturers. Type numbers and manufacturers' names and addresses are:

Acrosound TO-290—Acro Products Co., 369 Shurs Lane, Philadelphia, Pa.

Partridge CFB or WWFB—Partridge Transformers Ltd., Tolworth, Surrey, England. Available at many U. S. distributors and from Atlas Radio Corp., 560 King St. West, Toronto 2B, Canada.

Peerless S-265Q or S-227Q—Peerless Electrical Products Division of Altec Lansing Corp., 161 6th Ave., New York, N. Y.

Stancor A-8054—Standard Transformer Corp., 3580 Elston Ave., Chicago 38, Ill.

Triad HSM-89, HSM-90, and S-48A—Triad Transformer Mfg. Co., P. O. Box 17813, Los Angeles, Calif.

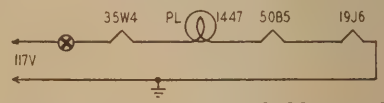
UTC LS-63—United Transformer Co., 50 Varick St., New York 13, N. Y.

If you cannot obtain any of these transformers through your local distributor, you can obtain the unit of your choice through most mail-order radio supply houses or directly from the manufacturer.

PILOT LAMP FAILURE

? *I have a type 1447 (19-volt) pilot lamp connected in series with a 35W4, 50B5, and 19J6 as shown in the diagram. The pilot lamp blows out as soon as I throw the switch. What causes this and how can I eliminate it?—G. S., Blue Earth, Minn.*

A. The trouble is probably caused by the combination of excess voltage across the string and the difference in the temperature coefficients of resistance of the lamp filament and the tube heaters.



Your tube heaters can probably stand a greater momentary overload than the pilot-lamp filament. You can probably prevent burn-outs of the pilot lamp by dropping the line voltage applied to the string.

You may be able to eliminate the trouble by inserting a 100-ohm, 5-watt dropping resistor between the switch and the 35W4 heater. A still better bet is to use a dropping resistor consisting of a 50-ohm, 2-watt resistor in series with a type 327F-1 *Globar* resistor. This particular Globar resistor has a resistance of 460 ohms cold and 35 ohms when hot. The initial high resistance of the 327F-1 resistor will limit the current surge which occurs when the switch is thrown, and will drop rapidly as the tubes warm up.

If you find that the line voltage does not rise above 117 volts, you may remove the 1447 pilot lamp from the circuit and use either the 100-ohm resistor or the 50-ohm and Globar resistors in series. The 1447 can then be replaced by a 117-volt pilot connected directly across the incoming line. Or you can use the 1447 and a 700-ohm, 20-watt resistor in series. END

CLEANING TUNING CAPACITORS

The application of a high voltage between stator and rotor will often clear up trouble in tuning capacitors that are noisy or shorted by dirt or scale between the plates. The necessary voltage can be taken from the power supply of the receiver being serviced. The drawing shows a simple gadget that can be used to apply the voltage to the capacitor. Be sure to disconnect all coils from the capacitor before applying the high voltage.—*Crosley Service Dept.*

STORING LARGE DRAWINGS

Engineers, technicians, amateurs, and experimenters often use mailing tubes for storing and transporting large blueprints, schematics, nomograms, wall-charts, and similar material. The usual procedure is to roll the material and insert it into the tube. The sheet then unrolls and hugs the inside of the tube so it is difficult to remove when needed.

To simplify removal and prevent damage to the sheet, wrap the roll in lightweight paper and carefully twist the ends of the wrapping. Now, insert the wrapped roll into the mailing tube and seal the ends. When needed, the material can be removed from the tube, all neatly wrapped and preserved. Untwist the ends of the outside wrapping and the material is available in its original condition.—*Joseph Zelle*

MOUNTING TV BOOSTER

To keep the top of my console TV set clear for photographs or flowers, I mounted my booster in the speaker compartment of the set. The booster is fastened to the back of the speaker mounting board so its control shafts extend through the board and grill cloth directly below the tuning control. I plan to install an antenna rotator control box in the same compartment on the opposite side of the mounting board. —*Vern Long*

STORAGE KINK

If you are cramped for storage space in the shack or workshop, this method of storing short lengths of brass, copper, aluminum rod, bus-bar, and other small metal strips may appeal to you. Make a simple container from a discarded section of thin-wall nickel-plated shower curtain rod, slightly over 3 feet long. Cap one end with a rubber crutch tip, place the rod stock inside the tube and cap the open end with another tip. This handy container could then be safely stacked away in a closet corner without its contents soiling other things stored in the closet. The ends of the tube won't scratch anything and you'll always know where to find your miscellaneous strip stock.—*John W. Sponsler*

SERVICING KINK

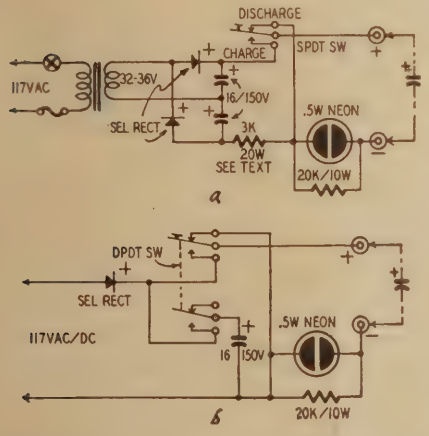
Replacing a charred or broken tube socket is quite a job in some of the midget sets which have most unused socket pins as tie points. When the service data does not include an under-chassis photo or wiring diagram (pictorial drawing), I sketch a picture of the under side of the socket showing all connections to its terminals. In this way, I can be sure of getting all components and connections back in their original places without wasting time tracing circuits.

For convenience on a job like this, I keep on hand a number of sheets of notebook paper with an enlarged sketch of an octal socket on each. When the job is finished, I file the sketch with the case records of the sets which I have repaired.—*J. C. Anderson*

CAPACITOR CHECKERS

Here are circuits of two capacitor leakage checkers which I have used with a great deal of success. They check capacitors by the "charge-discharge" method. Both feature instantaneous operation and freedom from complicated switching sequences—just press the button to charge the capacitor and release it to discharge.

The circuit at *a* is isolated from the line by the 32-36-volt filament transformer thus eliminating the possibility of a hot chassis. Circuit *b* operates directly from the power line. One section of the d.p.d.t. push switch is wired to remove the slight load imposed by



the 16-μf filter capacitor. This eliminates the need for a line switch.

The 20,000-ohm resistor speeds up the charging of electrolytic capacitors and drains off the residual charge left on the capacitor under test when the charge drops below the ignition voltage of the neon lamp.—*Andrew La Mantia*

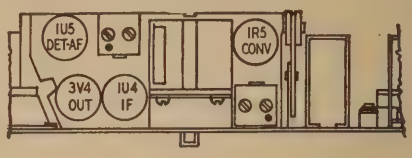
SALVAGED COIL FORMS

Recently I salvaged some coil forms which were grooved for spaced turns of No. 14 wire. To use these for coils consisting of close-wound turns of a much smaller wire, I filled the grooves with wax drippings, and then shaved off the excess wax with a knife. The wax filling enabled me to wind on an even layer of wire which stayed in place without trouble from slipping and overlapping.—*B. W. Welz*

END

RCA SERIES 2B400 PORTABLES

In a small quantity of these receivers, the positions of the 1U5 and 3V4 tubes are interchanged on the tube label in the corner back. The illustration shows the correct tube layout.



Corrections to the original label, if needed, may be made in pencil or ink to prevent possible confusion at some later date when tube replacements are made.—*RCA Service Tips*

EMERSON 649 TV RECEIVER

To eliminate a strong 60-cycle buzz which may be present even at low settings of the volume control:

Dress all leads to the picture tube socket as far from the 6T8 tube as possible. This operation is simplified by securing the green grid lead to the side of the cabinet.

Set the fine-tuning control for best picture. This should correspond to minimum buzz. If buzz is still heard at an annoying level, the sound or possibly the video i.f.'s and sound traps may have to be realigned.— *Emerson Field Service Bulletin*

SOUND I.F. INTERFERENCE

A herringbone or crosshatched interference pattern which varies with modulation may be caused by harmonics of the sound i.f. radiating from the discriminator circuit and re-entering the r.f. stage.

Check this by pulling the first sound i.f. tube. If this cures the trouble carefully check the sound i.f. and discriminator shield cans and wiring, and make a more positive connection between the shield cans and the chassis. You may find it desirable to place some solder on the chassis where the can contacts it. The can is then pulled into the solder when clamping it in place.

Also check the lead dress in the discriminator circuit, particularly the leads connected to the discriminator transformer. Make sure that they conform to all lead dress information contained in the manufacturer's service data.— *RCA Radio Phono TV Tips*

EMERSON 666 TV SET

This set had a peculiar intermittent horizontal tearing condition. After checking the sync and horizontal oscillator circuits, I found that the trouble originated in a defective 6AU6 tube in the second video i.f. stage. Replacing the tube cleared up the trouble— *Stephen A. Quering*

DODGE 1950 AUTO SETS

The usual complaint is a defective vibrator which requires frequent replacement. Use a Philco replacement vibrator part 83-0026. This is the only vibrator that I have which will last for any length of time in these sets.— *Gordon V. Weeks*

SENTINEL 420B, 423, 424

A semicircular shadow around the corners of the pattern is caused by slippage of the metal ring inside the focus magnet. It can be eliminated by the following procedure:

1. Rotate the hex stud on the left of the focus adjustment screw until the shadow is eliminated. This adjustment should be made with a copper, brass, or other nonmagnetic tool. (A focus magnet adjustment tool—part No. P-1004—can be obtained from the Factory Service Department.)
2. Adjust the ion trap for *maximum* brightness. **Do not use the ion trap to eliminate the shadow, if by so doing the brightness is decreased.**
3. Re-center the picture with the centering controls on the back of the chassis. **Do not use the horizontal hold control to center the picture.**—*Sentinel Service Dept.*

STROMBERG-CARLSON TV SETS

The series 16 TV receivers use three series-connected 680,000-ohm resistors in the voltage-doubler section of the high-voltage supply. Blooming when the brightness control is varied has been traced to failure of these resistors. Corona will burn and discolor the top resistor in the string and cause its resistance to increase.

This trouble can be eliminated and recurrence minimized by using four instead of three resistors in series in this position. The resistors are 2,000-volt type BTAV units (Stromberg-Carlson stock No. 149368).—*Stromberg-Carlson Current Flashes*

MOTOROLA TS-324A CHASSIS

Some early production TS-324A chassis lack sufficient width to completely fill the screen when line voltage is low. These chassis are not equipped with raster corrector or magnets. In most cases, an adequate increase in horizontal size can be obtained by installing a pair of corrector magnets and anti-corona shields when the set has a metal-cone picture tube. The right-hand magnet and shield assembly is part No. 1V721584 and the assembly for the left side is No. 1V721585.

In some of these sets, National Union 6BQ6-GT tubes suffered rather rapid deterioration which was responsible for some loss in width. A new flyback transformer was used in later models to increase the high voltage and to eliminate the width and tube problems. It is recommended that 6BQ6's of brands other than National Union be used as replacements in chassis coded TS-324A-03 or earlier. Chassis coded TS-324A-04 and later have the new transformer which eliminates these problems.—*Motorola Service Bulletin*

FADA FM TUNER MODEL 795

If the set is dead and a rushing noise can be heard from the speaker, try replacing the 6BE6 oscillator tube. This trouble is often caused by a defective tube which checks O.K. on a transconductance tube checker.—*Wilbur J. Hantz*

END

HELP - FREDDIE-WALK FUND

Freddie, as most of our readers know, was born without arms or legs and must depend upon artificial means for the ordinary locomotion we others take for granted.

The Help-Freddie-Walk Fund, organized to help defray the expense of the special treatments and mechanical appliances Freddie will need all his life, has now reached the $10,300 mark—but the end is still nowhere in sight. Many thousands more will be needed before Freddie can be assured a normal life, and we would like to express our sincere appreciation of the response we have had to date.

We urge that each and every reader help this worthy cause by sending in his contribution, no matter how small, as soon and as often as possible. *Make all checks, money orders, etc., payable to Herschel Thomason.* Address all letters to:

HELP-FREDDIE-WALK FUND
c/o RADIO-ELECTRONICS Magazine
25 West Broadway
New York 7, New York

FAMILY CIRCLE CONTRIBUTIONS

Balance as of November 17, 1952 ..	$571.50
Catherine T. Haley, Chicago, Ill. ..	1.00
Mary Krull, Passaic, N. J.	5.00
FAMILY CIRCLE Contributions as of December 22, 1952	$ 577.50

RADIO-ELECTRONICS CONTRIBUTIONS

Balance as of November 17, 1952 ..	$9,591.47
Agriculture Dept. Employees, Washington, D. C.	8.50
Anonymous, Butler, Pa.	1.00
Anonymous, San Antonio, Texas ...	.25
Anonymous, Washington, D. C.	1.00
John Barnick, Edmonton, Alta., Canada	5.00
R. Z. Binks, Washington, D. C.	1.00
W. P. Dieffenbach, % P.M., San Francisco, Calif.	10.00
Lawrence Engle, % P.M., N. Y.	10.00
Garrett Radio Service, Sedalia, Missouri	1.00
Hartmann Radio & Television, Woodside, L. I.	5.00
Jensen Electric Co., Melrose Park, Ill.	1.00
Howard F. Keller W9HHY, Lewisburgh, Pa.	1.00
Fred A. Layton, Stockton, Calif.	5.00
M. Gordon Moses, Schenectady, N.Y.	5.00
Officers, USNS Ocklawaha, % Marine Transport Lines, Inc., N.Y.C. .	30.00
Frank R. Olding, Coral Gables, Fla.	5.00
Mr. & Mrs. A. L. Pammer, Allentown, Pa.	5.00
F. C. Purkeypile, Corvallis, Ore. ...	10.00
Joe & Jean Royer, Pilot Rock, Ore. .	1.00
Sally Ann Shoemaker, Pittsburgh, Pa.	2.00
Jack Siegel, Portsmouth, Virginia ..	10.00
Gray C. Trembly, Terra Alta, W. Va.	10.00
Wm. E. Tucker, Pittsburgh, Pa.	10.00
R. Villiers, Louisville, Kentucky	2.00
RADIO-ELECTRONICS Contributions as of December 22, 1952	$9,731.22
FAMILY CIRCLE Contributions	577.50
TOTAL CONTRIBUTIONS as of December 22, 1952	$10,308.72

WALSCO UHF

Some of the figures printed in the Walter L. Schott Company ad of the above name on page 104 of the January issue were incorrect. The correct figures, referring to gain in decibels of Walsco UHF antennas, are below:

Freq. MC	Gain in db.* Mod. 4400	Mod. 4402	Mod. 4450
500	6.1	8.4	7.8
600	7.6	10.6	8.9
700	8.9	11.9	11.
800	7.9	11.3	12.9
900	7.0	9.0	11.8

WHOSE LIFETIME?

Permanent needles are not as enduring as many people have been led to believe by glib salesmen who talk about "lifetime" needles. This fact was stressed by Peter L. Jensen, president of Jensen Industries, who pointed out that the term "lifetime" is a relative one, and what may be meant is the lifetime of the needle. Mr. Jensen stated that many expensive phonographs sound worse than the cheapest of the cheap because the so-called permanent needle is worn. The record customer then blames the quality of the records rather than the needle.

Mr. Jensen's solution to this problem is to impress on the public the need for changing "lifetime" needles frequently.

Radio Thirty-Five Years Ago

In Gernsback Publications

HUGO GERNSBACK
Founder

Modern Electrics	1908
Wireless Association of America	1908
Electrical Experimenter	1913
Radio News	1919
Science & Invention	1920
Television	1927
Radio-Craft	1929
Short-Wave Craft	1930
Television News	1931

Some of the larger libraries still have copies of ELECTRICAL EXPERIMENTER on file for interested readers.

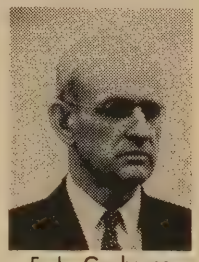
February 1919 ELECTRICAL EXPERIMENTER

The New Wireless, by H. Gernsback
My Inventions, by Nikola Tesla
Amateurs Win Questionable Victory, by H. Gernsback
President Wilson Always in Touch with Washington—via Radio
Vacuum Valve Action and the Electric Current, by K. G. Ormiston, Assoc. I.R.E.
Three Good "Hookups" for a Small Receiving Set, by Fred Floyd, Jr.
Efficient Galena Detector, by H. C. Benedict, Jr.
A Handy Adjustable Condenser, by H. B. Massingill
The Vortex Ring Theory of the Electron, by F. W. Russell and J. L. Clifford
Experiments in Radio-Activity, by Ivan Crawford

O. E. Bishop, former sales service manager of P. R. MALLORY & Co., Indianapolis, was promoted to manager of sales operations, Distributor Division. He will assist J. E. Templeton, Distributor Division Manager. Dan Mischler, formerly distributor representative in the Pittsburgh and Rochester areas, succeeds Mr. Bishop as sales service manager.


O. E. Bishop

Vice-Admiral Edward L. Cochrane, USN (Ret.), Dean of the School of Engineering at the Massachusetts Institute of Technology, was elected a director of RAYTHEON MANUFACTURING Co., Waltham, Mass. Admiral Cochrane was a Raytheon director from 1948 to 1950 when he went to Washington to direct the Maritime Administration. During World War II, he served as chief of the Bureau of Ships, and, after the war, as chief of Naval Materiel.


E. L. Cochrane


W. W. Taylor

William W. Taylor was promoted to assistant sales manager of the SANGAMO ELECTRIC Co. Capacitor Division, at Marion, Ill. He was formerly sales promotion manager. Bruce E. Vinkemulder, formerly distributor sales manager, succeeds Taylor as sales promotion manager of the division. A. E. McCluskey, former sales office manager, is the new distributor sales manager of the Capacitor Division.

Victor Machin, former assistant general sales manager of SHURE BROTHERS, Chicago, was promoted to the position of general sales manager and vice-president in charge of sales. He succeeds J. A. (Jack) Berman who resigned from the company to become a sales representative in Southern California. J. H. (Joe) Morin continues in the position of distributor sales manager.


V. Machin

. . . **Dr. V. K. Zworykin**, vice-president and technical consultant of RCA LABORATORIES DIVISION of RCA, Princeton, N. J., and a pioneer researcher in electronics, was awarded the 1952 Edison Medal by the American Institute of Electrical Engineers, "for outstanding contribution to the concept and design of electronic components and systems."

OPPORTUNITY AD-LETS

Rates—45¢ per word (including name, address and initials). Minimum ad 10 words. Cash must accompany all ads except those placed by accredited agencies. Discount, 10%, for 12 issues. Misleading or objectionable ads not accepted. Copy for April issue must reach us before March 21, 1953.

Radio-Electronics, 25 W. Broadway, New York 7, N. Y.

ELECTRONIC COMPONENTS AND EQUIPMENT NEEDED, send details for offer. Bargain literature. "Electronic Outlet," Box 72, Lawrence, Mass.

TUBES AND EQUIPMENT BOUGHT, SOLD AND EXCHANGED. For a fair deal send details to B. N. Genster, W2LN1, 136 Liberty, N. Y. 6, N. Y.

WANTED—TOP PRICES PAID—Navy Selsyns 1DG, 1F, 1CT, 5CT, 5D, 5DG, 5G, 6G, 7G, etc. and BC-348, BC-221, AN/ARC-1, AN/ART-3, AN/ARC-3, RTA-1B, AN/APR-4. Lectronic Research, 712 Arch St., Philadelphia, Pa.

BUY WHOLESALE—25,000 ITEMS—CATALOG 25¢. Matthews, 1472-P5 Broadway, N. Y. C. 36.

ALL TYPES OF ANTENNAS FOR AMATEUR AND TV. Aluminum Tubing. Willard Radcliff, Fostoria, Ohio.

RADIO CONTROL COMPONENTS. ATTRACTIVE PRICES. 207 Lyon Block Building, Albany, New York.

LOW COST TELEVISION! RECONDITIONED receivers, 10" $50, 12", $60 up. Spitz, 1420 South Randolph Street, Arlington, Virginia.

TV-FM ANTENNAS. ALL TYPES INCLUDING UHF. Mounts, accessories. Lowest prices. Wholesale Supply Co., Lunenburg 2, Mass.

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If you're moving, please don't forget to send us your address as it appears on the copy of the magazine, including the numbers shown beside your name, as well as your new address.

If we receive this information before the 20th of the month, you will continue getting the magazine without interruption.

Your cooperation will be most helpful and greatly appreciated.

Raymond K. McClintock was appointed to the newly created position of manager of new product promotion for SYLVANIA ELECTRIC PRODUCTS, INC., with headquarters in New York City. He has been with Sylvania since 1936 and was most recently assistant chief engineer of the Radio Tube Division.


R. K. McClintock

Gaius Wike was appointed general sales manager of UTAH RADIO PRODUCTS CO., INC., Huntington, Ind. He was formerly assistant sales manager of Utah since 1951.

Howard C. Stacey, formerly assistant sales manager of the Sound Sales Division of WEBSTER ELECTRIC CO., Racine, Wis., was promoted to sales manager of the division. In his new position he will direct the sales activities of the entire Webster Electric sound line.


H. C. Stacey

Obituary

S. B. Darmstader, pioneer Chicago manufacturers' representative, died recently at Alexian Brothers Hospital, Chicago, at the age of 66, after a brief illness.

Personnel Notes

. . . **William A. Damerel** joined LAPOINTE-PLASCOMOLD CORP., Rockville, Conn., manufacturer of *Vee-D-X* antennas, boosters, and accessories, as assistant to the president. He was formerly an executive with the Whitney Chain Co.

. . . **Robert B. Sampson**, a veteran of 10 years with RCA VICTOR DIVISION in finance and business activities, was appointed administrator of the new Tube Department Business and Financial Consulting Service. The service was established to aid the company's distributors of tubes, parts, test equipment, and batteries to prepare for the anticipated expansion of electronics markets.

. . . **William J. Doyle** has resigned as vice-president in charge of sales of ASTATIC CORPORATION, Conneaut, Ohio, to become a manufacturers' representative in the Chicago area.

. . . **John J. Bohrer**, former chemical research group leader of INTERNATIONAL RESISTANCE CO., Philadelphia, was promoted to assistant director of research.

. . . **Sylvan (Sy) A. Wolin**, resigned as vice-president in charge of sales of PYRAMID ELECTRIC CO., North Bergen,

N. J., capacitor manufacturer, to establish his own advertising agency, Sylvan A. Wolin & Associates, in Englewood, N. J. The agency will handle the Pyramid advertising account, and Mr. Wolin will act in an advisory capacity to the company.

. . . **Grady L. Roark** was appointed manager of equipment tube sales for GENERAL ELECTRIC TUBE DEPARTMENT, Schenectady, N. Y. He had been central regional manager for equipment tube sales.

. . . **Bernard L. Cahn,** general sales manager of the INSULINE CORP. OF AMERICA, Long Island City, N. Y., was elected vice-president of the company.

. . . **R. K. Gilbert** was appointed operation manager of the Chicago plants of STANDARD COIL PRODUCTS CO., INC. He was formerly with Philco. In his new position, Mr. Gilbert will assist Stanley Andrews, vice-president in charge of production of the four plants in the Chicago area.

. . . **John Feltman** was named assistant manufacturing manager of the Cathode-Ray Tube Division of ALLEN B. DU MONT LABORATORIES, INC., Clifton, N. J. He had been assistant manufacturing manager of the Receiver Division. The company also announced three promotions in the Instrument Division: H. B. Steinhauser to manufacturing engineer; L. E. Florant to head of the Engineering Services Section; and A. W. Russell to head of the Electrical Design Section.

. . . **John P. Dillon** was assigned to the Distributor Sales Department of CLAROSTAT MANUFACTURING CO., Dover, N. H. He recently rejoined Clarostat after being recalled to active duty with the Navy. He replaces Dominic Leone who now heads distributor sales in the Chicago area.

. . . **Roland J. (Rollie) Sherwood,** vice-president in charge of sales for Hallicrafters Co., Chicago, resigned to become president of WALER MANUFACTURING CO., Crystal Lake, Ill., automotive, farm, and electrical machinery parts manufacturer.

. . . **Jack Moore** was appointed national factory sales manager for DAVIS ELECTRONICS, Burbank, Calif., manufacturer of TV antennas and allied products.

. . . **L. M. Clement,** Crosley Division, AVCO MANUFACTURING CO., was named chairman of the Executive Committee of the newly enlarged Receiver Section of the RTMA ENGINEERING DEPARTMENT. The section recently expanded and changed its name to General Electronics and Receiver Section.

. . . **Sidney Pariser, president of** RADIO MERCHANDISE SALES, INC. (RMS), New York City, was recently honored by his firm to mark his 25 years in the radio and TV parts industry. END

THE ELECTRONIC FLAME

Dear Editor:

I read Thomas E. Fairbairn's article, "Electronic Flame," in the December, 1952, issue with considerable interest—not in the phenomenon itself but rather in the nature of its manifestation.

The electronic flame described in the subject article is I believe akin to the natural manifestation broadly classified as St. Elmo's Fire, which has always frightened seafaring men. The same phenomenon frequently makes flyers jittery when flying through thunderstorms. Sometimes every projection on the aircraft seems to be on fire.

Under another name, "precipitation static," a lower potential form which does not "flame," it makes radio communication with the aircraft impossible. It is quite common for aircraft flying in certain kinds of weather to accumulate a static charge of more than 250 kilovolts.

Mr. Fairbairn asks, "What is this electronic flame?" I will attempt to answer him:

He states that glass conducts current only when in the melted state. This is not entirely correct. Glass will conduct current, though very slightly, even at ordinary room temperatures and its conductivity progressively increases with increasing temperature. In fact, two electrodes sealed into a glass bead make an excellent temperature-sensitive resistor for use at temperatures above about 300° C. Therefore, in view of the extremely high potential at the end of the tank coil and the small current required by the electronic flame, a sufficient number of electrons can pass through the cold glass rod to form the flame.

We have an apparatus which does the same job as Mr. Fairbairn's 1-kw, 14-mc transmitter. Ours was built at a very small fraction of his cost; it has extremely modest power requirements and should not offend the FCC. This apparatus was built for electroforming high-voltage selenium rectifiers. The complete circuit is shown in the sketch on page 125. The transformer is an ordinary 12-kv, 24-ma neon sign unit which happened to have the mid-point of the high-voltage winding grounded to the case. It is necessary to refer to this apparatus because the phenomena connected therewith serve to explain the why of the electronic flame.

With this apparatus, the ends of two wires connected to the positive and negative outputs are spaced ¼- to ½-inch apart and the line cord is plugged in. The flame starts promptly.

Here a curious thing happens. The end of the wire which is connected to the negative terminal glows brightly and melts into a ball on the end of the wire. The wire connected to the positive terminal does not melt, and, if of the same diameter as the other wire, hardly reaches a dull red heat. If the wires are of iron, a brilliant shower of sparks (incandescent iron particles) erupts from the negative wire during the melting, which takes place in only a few seconds.

The melting of the negative wire widens the gap, and therefore the length of the flame, to about ¾ inch, at which point no further melting occurs and the flame settles down to a nice silent fire drawing 30–35 ma at 2,000 volts.

The flame is fire in every sense of the word. Inflammable materials introduced into the flame promptly burn. Small-gauge copper wire held in the flame promptly melts. Light emitted by the flame and by the incandescent ball on the end of the negative wire extends from the infra-red to the ultra-violet. Fluorescent materials fluoresce, though weakly, when held near the flame. The spectrum of this flame and the incandescent negative wire has a sharply defined orange line corresponding to a wavelength of approximately 0.6 micron. A piece of glass placed in the flame produces the characteristic sodium line in the spectrum. It is my opinion that the aforesaid orange spectrum line is due to burning of dust particles in the air surrounding the flame, or more probably to one of the rare gases in air.

That this is a flame rather than the customary corona or spark discharge is evidenced by the *total absence of the odor of ozone which is characteristic of such discharges.* Like any flame, this one wavers about with each small draft of air.

I have found this phenomenon useful for welding copper-iron thermocouples made of up to No. 20 AWG wire or for welding copper wires together. For welding, the flame should be turned off as soon as the molten ball forms, because if the flame is continued the whole ball becomes converted to oxide which is very brittle and may be broken off with the fingers.

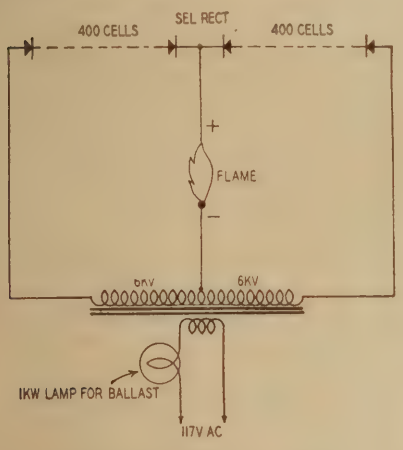
This flame seems to be truly an "electronic flame" in every sense of the term. The reason for only the negative wire melting is due to the following actions, two of which occur also in Mr. Fairbairn's high-frequency version:

1. The fact that current does flow through the flame is conclusive proof that a large number of electrons are moving through it. These electrons presumably leave the surface of the negative wire at high speed, which enables them to ionize the gas molecules comprising the air with which they must collide with considerable force. The flame therefore must be composed largely of ionized gas, plus free electrons. As the electrons must be literally torn from their orbits in the metal atoms comprising the negative wire, the energy level of these surface atoms rises. With a rise in energy level, there is an increase in temperature, which tends to free more electrons from the surface atoms. Electrons continue to be torn out of the surface orbits faster than they can be replaced by the relatively slow movement of electrons through the wire until at last the metal comprising the end of the wire melts. In melting, the characteristic ball is formed, presenting a larger surface from which the electron supply can be

secured, thereby drastically reducing the energy per unit area and permitting the ball to cool below the melting point.

2. The surface of the negative wire must be simultaneously bombarded by positive gas ions in the portion of the flame adjacent to the negative wire; some heat must be contributed by the collision; the positive ion extracts electrons from the surface atoms.

3. Oxidation is of itself exothermic, once the temperature reaches a critical temperature depending upon the metal. That is, above a certain temperature, the reaction is accompanied by the liberation of heat.



In the high-frequency version of the electronic flame, the melting of the wire or glass must be due to bombardment of the tip by the ionized gas particles comprising the flame, and, in the case of wire, by exothermic oxidation.

H. B. CONANT

Conant Laboratories
Lincoln, Nebraska

CORRECTION

One line of type missing from the right-hand column of page 41 of the December, 1952, issue destroys the meaning of the first paragraph under the subhead "Tone-color circuits." The first sentence of this paragraph should read: *An infinite variety of tone colors can be produced with various combinations of resistance, capacitance, and inductance across the secondary of the isolating transformer.*

We thank Mr. Don Jeerings, of Walworth, N. Y., for his proofreading which detected the missing line of type.

The 6SJ7 (Fig. 2, page 40) was operated without a d.c. return on its control grid in the original model. In some cases, this may cause improper operation because of grid blocking. If the circuit does not operate when wired as shown, try grounding the grid through a very high resistance. Start with about 20 to 50 megohms and vary the value for optimum performance.

The line-voltage input terminals are marked 117 volts a.c. or d.c. in the diagram in Fig. 1, on page 34 of the December issue. The amplifier shown in this diagram can *not* be used on d.c. lines because the filaments are supplied from a transformer, and the B-supply is a voltage doubler.

Any or all of these catalogs, bulletins, or periodicals are available to you on request direct to the manufacturers, whose addresses are listed at the end of each item. Use your letterhead—do not use postcards. To facilitate identification, mention the issue and page of RADIO-ELECTRONICS on which the item appears. All literature offers void after six months.

TUBE BOOKLETS

Two new booklets have just been issued on Raytheon tubes.

The booklet *Reliable Cathode Type Subminiature Tubes* includes the five types which were in the first edition, now corrected in accordance with JAN designations, plus six new additions to the line. These include a low-heater-power dual diode, three dual triodes with amplification factors of 20, 35, and 70, a voltage-reference tube, and a voltage-regulator tube.

The booklet, *Special Purpose Tube Characteristics*, includes subminiature, rugged, and radiation-counter tubes, "Reliable" tubes of both miniature and subminiature construction, germanium crystal diodes, transistors, rectifier tubes, voltage-regulator and voltage-reference tubes, and thyratron tubes.

Copies gratis upon request to Raytheon Mfg. Co., 55 Chapel St., Newton 58, Mass.

TUNGAR BULBS

Tungar bulbs are described in an 8-page data manual issued by General Electric. The bulletin contains charts and graphs illustrating the characteristics, construction, operation, and application of these bulbs, which are used for rectifying a.c.

Copies of GEA-5677 gratis upon request from General Electric Co., Schenectady 5, N. Y.

CENTRALAB CATALOG

Centralab catalog No. 28 is a 32-page booklet covering over 400 items. Variable resistors, ceramic capacitors, rotary and lever switches, printed electronic circuits, and steatite insulators are included. The booklet is illustrated and indexed.

Copies can be obtained without charge by writing Centralab, 900 East Keefe Ave., Milwaukee 1, Wis.

TWO-WAY RADIO

An 8-page illustrated booket outlining the use of two-way radio in industry and showing G-E two-way radio equipment is now available.

Request "Instant Communication" from the Advertising Inquiry Section, General Electric Co., Electronics Park, Syracuse, N. Y.

VIBRATRON DATA

A 4-page booklet describing the model 652 *Vibratron* vibration analysis instrument has been released by the International Research and Development Corp.

Available free of charge from International Research and Development Corp., Columbus, Ohio. END

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MEISSNER "HOW TO BUILD" INSTRUCTION MANUAL. Published by Thordarson - Meissner Manufacturing Division, Maguire Industries, Inc., Mt. Carmel, Ill. 8½ x 11 inches, 160 pages. Price $1.50.

After almost ten years, the old familiar Meissner manual is back with us—bigger and better than ever. The material is divided into six groupings. The first contains charts, graphs, and tables of radio formulas, conversion factors, color codes, and other data that engineers and beginners alike should have at their fingertips.

The second grouping contains general information and theoretical material on loudspeakers, phonograph pickups, FM, and TV test patterns.

Section three contains schematics, pictorial diagrams, parts lists, and full construction details on Meissner kits, which now include a two-tube novice 80-meter c.w. transmitter and receivers ranging from a battery-operated all-wave regenerative two-tuber to elaborate FM tuners and multiband AM sets.

The fourth section includes diagrams, photographs, and operating instructions on Meissner tuners and receivers and Thordarson phonograph amplifiers which are available as factory-wired units.

Approximately 30 pages and about 100 diagrams are included in the fifth section which provides a wealth of practical circuits for the builder and experimenter. Almost every conceivable type of transmitter, receiver, test instrument, control device, and simple electronic appliance may be found in this section. Many of the diagrams are reprinted from manufacturers' bulletins and electronic books, manuals, or magazines with little or no descriptive material. On some of the diagrams, a few critical components have no values or are not fully described. This is likely to present difficulties to those readers of the manual who lack the background necessary to estimate or make a reasonable guess at the value of the unmarked component.—*RFS*

TELEVISION by F. Kerkhof and W. Werner. Published by Philips Technical Library. Distributed by Elsevier Press, Inc., 402 Lovett Blvd., Houston, Texas. 6 x 9 inches, 475 pages. Price $7.75.

This book describes American, British, French and Dutch TV systems. Physical concepts are clearly given. For those who like the completeness of math, equations and analyses are provided, usually in separate paragraphs and fine type.

The authors describe all phases of their subject in much detail. Circuit design, theory and principles are well presented and illustrated. Because it is so comprehensive, this volume is far more valuable to the technician than the many popularized books now available. Some of the chapters and topics are: pickup and picture tubes, relaxation circuits, scanning, time bases, wideband amplifiers, transmission lines, antennas, color (RCA and CBS).

Plenty of schematics, diagrams and illustrative waveforms are included.

—*IQ*

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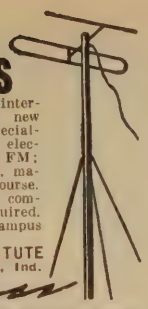

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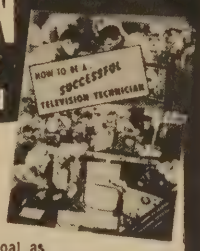

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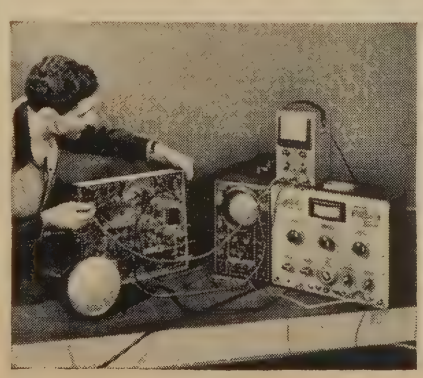

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WHAT YOU SHOULD KNOW ABOUT TELEVISION, by Jacob H. Ruiter, Jr. Published by J. H. Ruiter Publishing Co., Somerville, N.J. 8¼ x 7½ inches, 100 pages. Price $1.00.

Written in question-and-answer style, this book is for the television-set owner with no technical knowledge. Its 10 chapters cover purchasing and installing a TV set; the servicing problem; TV programs and their effect on the life of the set owner and his family; and some of the angles of TV-program production and presentation. There is also a little information on the technical side, both transmission and reception; information on simple TV servicing; and a few glances at the probable future of TV, including the answers to such questions as "What is the status of color?" and "What is u.h.f. television?"

The author, who is manager of technical publications at the Allan B. Du Mont laboratories, and author of books on the oscilloscope, is an authority on his subject. The questions are reasonably well chosen and are answered in clear lay language, with minimum of technical terms.

Many points are driven home by excellent and highly graphic illustrations, and the table of contents—which lists all the questions in the book—makes it easier for the set owner to find what he wants to know.—*FS*

ELECTRICAL MEASUREMENTS MANUAL, by C. H. Dunn and H. J. Barker. Published by Prentice-Hall, Inc., New York, N. Y. 5½ x 8½ inches, 112 pages. Price $4.35.

This manual is written to accompany an elementary laboratory course in measurements. The first chapter discusses laboratory technique in general. It is followed by 35 separate experiments. They show how to make measurements and calibrations, how to use meters, bridges, and scopes, and how to plot curves, etc.

Each of the experiments is preceded by a brief discussion and ends with relevant questions. A simple diagram shows how to connect the equipment.—*IQ*

ELECTRONICS EVERYWHERE, by Professor A. M. Low. Published by John Day Co., 210 Madison Ave., New York, N.Y. 5 x 7½ inches, 191 pages. Price $2.50.

Professor Low shows the ability to discuss technical subjects in a popular style which has distinguished a number of British authors. This book is aimed at the reader of popular technical magazines, who will find it easy and instructive.

The subjects cover all fields of electronic endeavor, from diode "valves" to mass spectrometers, and from radar to electronic computers. Fluorescent and infra-red light are included, along with phototubes, electronic music, and encephalography. Even the role of electronics in nuclear research and the possibilities of broadcasting from man-made satellites in space are discussed.—*FS*

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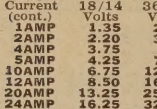

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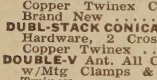

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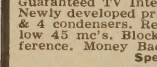

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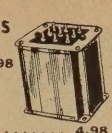

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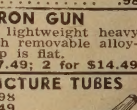
ONE YEAR GTD PICTURE TUBES



10 BP4	**$13.98**
10 BP4A	**14.49**
12" Glass	**17.95**
12" Metal	**21.98**
14" Rectangular	**20.95**
16" Glass	**23.98**
16" Metal	**23.98**
17" Rectangular	**23.49**
19" Round	**27.98**
20" Rectangular	**29.95**
21" Rectangular	**39.98**

Your old pict. tube is worth money, write for trade-in allowances on RMA coded and dated tubes with one year guarantee. Ship your defective picture tubes prepaid only. When ordering metal tube, defective metal tube is required.

TUBES

***From This Special List We Ship $10.00 and Up Tube Orders At Our Expense (Postpaid) Within Continental Limits of U.S.A. 90 Day Guarantee Tubes.**

0A2	.95	6BQ7	2.15	12BH7	1.29	CK538DX	.98
0A3/VR75	1.04	6BY5G	1.45	12BY7	1.15	CK539DX	2.19
0B2	1.37	6CB6	.69	12BZ7	1.25	CK541DX	1.99
0B3/VR90	1.09	6CD6G	1.69	12SA7GT	.69	CK542DX	.99
0C3/VR105	1.15	6D4	2.70	12SC7GT	.72	CK543DX	.99
0D3/VR150	.90	6J4	6.66	12SF5GT	.72	CK544DX	.99
1B3/8016	.81	6J5GT	.47	12SF7GT	.49	CK546DX	1.99
5R4GY	1.39	6J6	.63	12SG7	.83	CK547DX	1.98
5R4GYW	1.75	6K4A	6.45	12SH7	.63	CK571AX	2.49
5U4G	.69	6L6	2.35	12SJ7GT	.55	CK573AX	3.49
6AG5	.79	6L6G	1.35	12SK7	.72	CK1005	.85
6AG7	1.39	6L6GA	1.35	12SL7GT	.65	CK1027	2.98
6AH5G	1.49	6L6GAY	2.29	12SN7GT	.75	CK1028	1.
6AH6	1.22	6SA7GT	.63	12SQ7GT	.63	CK1089	2.99
6AJ5	1.40	6SA7GTY	3.37	19T8	1.49	CK1090	2.98
6AK5	.74	6SB7Y	1.19	19V8	1.62	CK5672	1.29
6AK5W	2.98	6SC7	.90	25BQ6GT	1.19	CK5676	1.29
6AK6	1.05	6SD7GT	.80	25L6GT	.69	CK5678	1.89
6AL5	.54	6SF5	.77	25Z5	.75	5687	5.49
6AL7GT	1.29	6SF7	.73	25Z6GT	.99	CK5703	1.49
6AN5	2.90	6SG7	.72	28D7	1.95	CK5703	1.29
6AQ5	.55	6SH7	.61	35Z5GT	.59	Xtal Diodes	
6AQ5W	3.98	6SJ7	.70	50L6GT	.69	1N21A	1.55
6AQ6	.81	6SK7GT	.59	80	1.69	1N21B	3.00
6AQ7GT	1.29	6SL7GT	.69	81	1.69	1N21C	21.50
6AR6	2.98	6SN7GT	.70	82	1.19	1N22	1.25
6AS5	.79	6SN7WGT	2.25	82V	1.39	1N23	1.35
6AS6	2.43	6SQ7GT	.63	83	1.45	1N23A	2.35
6AS7G	4.14	6SR7	.65	83V	1.79	1N23B	3.49
6AT6	.63	6SS7	.75	84/6Z4	.99	1N25	4.98
6AU5GT	1.10	6ST7	.98	117L/M7GT	1.59	1N26	8.75
6AU6	.59	6SU7GTY	2.69	117N7GT	1.79	1N27	1.55
6AV5GT	1.29	6V6	1.39	117P7GT	1.49	1N32	3.50
6AV6	.49	6V6GT	.57	117Z6GT	1.19	1N32	23.75
6AW6	1.89	6W4GT	.57	117Z7GT	1.49	1N34	.64
6B4G	1.23	12AH7GT	1.45	CK501X	1.26	1N34A	.90
6BA6	.63	12AK5	1.98	CK502AX	1.49	1N35	1.65
6BA7	1.27	12AK5W	4.	GL502A	1.79	1N38	1.43
6BC5	.63	12AL5	.75	CK502AX	1.49	1N39	4.15
6BC7	1.23	12AT6	.52	CK503AX	1.49	1N44	1.24
6BD5GT	1.65	12AT7	.81	CK505AX	1.79	1N45	1.45
6BD6	.83	12AU6	.72	CK506AX	1.79	1N47	5.49
6BE6	.59	12AU7	.63	CK509AX	1.79	1N48	.59
6BF5	.98	12AV6	.49	CK512AX	1.45	1N51	.45
6BF6	.65	12AV7	.98	CK522AX	1.29	1N52	1.62
6BF7	2.85	12AW6	1.79	CK525AX	1.29	1N54	.89
6BG6G	1.39	12AX4GT	1.20	CK526AX	1.49	1N56	.89
6BG7	1.98	12AX7	.79	CK528AX	1.49	1N57	.89
6BH6	.63	12AY7	2.95	CK529AX	1.79	1N58	1.19
6BJ6	.99	12AZ7	1.49	CK531DX	1.89	1N60	.60
6BK7	2.15	12BA6	.73	CK532DX	1.89	1N61	2.10
6BL7GT	1.45	12BA7	.79	CK533AX	1.29	1N63/K63	2.49
6BN6	1.49	12BD6	1.23	CK534AX	.99	1N64	.69
6BN7	1.69	12BE6	.59	CK536AX	.99	1N67	1.95
6BQ6GT	1.20	12BF6	.85	CK537AX	3.04	1N69	1.19

THAT'S A BUY "TAB" THAT'S A BUY

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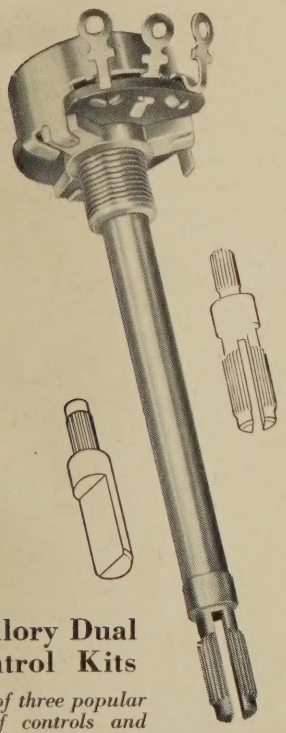

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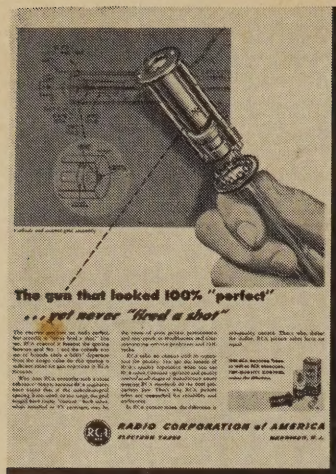

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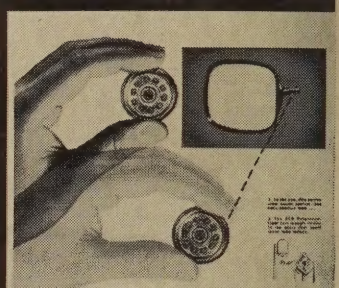

A *DOUBLE-TAKE*
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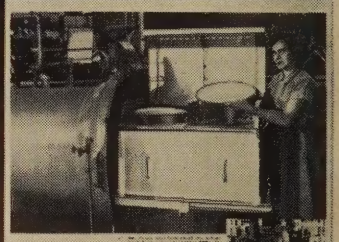

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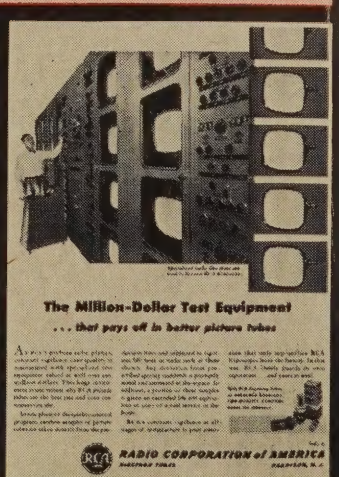

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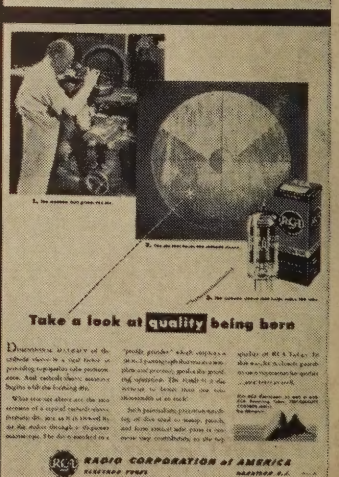

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